

FEBRUARY 1989 / \$2.50

HAM RADIO



Howland PA0CX

D 098982 0689 FY9 1WSKHT HRP0
ROBERT B COOPER JR
PO BOX 100858
FORT LAUDERDALE FL 33310



HIGH PERFORMANCE

ICOM has a commitment to high performance 220MHz gear. That's why we're the only manufacturer who can offer you a full line of 220MHz equipment...whether it's a mobile, handheld, base station transceiver, or fiber optic multi-bander.

Handhelds. Choose the full-featured five-watt **IC-03AT** with 10 full function memories capable of storing odd offsets and subaudible tones, scanning and

DTMF direct keyboard entry. Or select the **IC-3AT** easy-to-operate handheld featuring thumbwheel switch frequency selection.

Mobiles. ICOM offers the **IC-38A**, which sports a large LCD readout, 21 memories, scanning, and memory lock-out. The slim-line **IC-37A** features an LED readout, nine memories capable of storing offset and subaudible tones and both memory and band scan.

Base Station. The **IC-375A** is a 220MHz all mode operator's dream...25 watts output, an internal power supply, 99 memories, scanning, and all subaudible tones built-in.

Multi-Bander. The newest addition to ICOM's 220MHz family...the **IC-900** fiber optic controlled six-band mobile, which has a 220MHz optional band unit.

Quality. High Performance. That's ICOM 220MHz.

NEW! IC-375A Transceiver



IC-37A Mobile



IC-38A Mobile



IC-03AT Handheld

IC-3AT Handheld

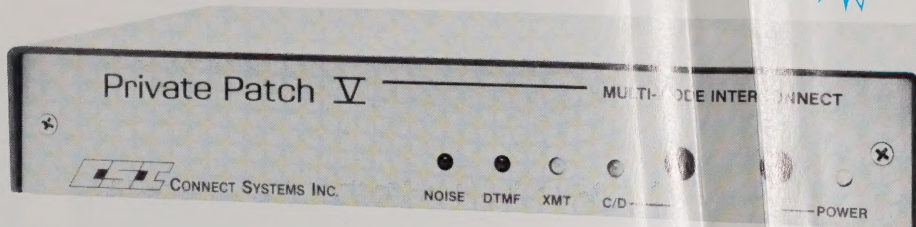
ICOM 220MHz

ICOM
First in Communications

ICOM America, Inc., 2380-116th Ave. N.E., Bellevue, WA 98004 Customer Service Hotline (206) 454-7619
3150 Premier Drive, Suite 126, Irving, TX 75063 / 1777 Phoenix Parkway, Suite 201, Atlanta, GA 30349
ICOM CANADA, A Division of ICOM America, Inc., 3071 - #5 Road, Unit 9, Richmond, B.C. V6X 2T4 Canada

All stated specifications are approximate and subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions. 220MHz:8B7.

FOUR user selectable operating modes and a 90 number autodialer make Private Patch V the **ONLY** choice!



SELECT AN OPERATING MODE USING THE BUILT-IN KEYBOARD . . .

1. SIMPLEX SAMPLING PATCH

Private Patch V achieves a level of sampling patch performance unobtainable in any other product. Crucial to performance is the noise squelch filter. Compare our five pole filter to the competition's two pole filter. Advanced software algorithms perform noise correlation tests which result in greater useable range than the competition. Nine selectable VOX enhancement ratios allow you to vary performance from straight sampling to highly VOX enhanced. (sampling rate decreased while the land party is speaking). The mobile is in full control and can break-in at any time.

2. SIMPLEX VOX PATCH

VOX mode offers superb simplex operation with any radio, including synthesized and relay switched models. VOX mode has other advantages too. **1.** A linear amplifier can be used to extend straight simplex range. **2.** You can operate through any remotely located repeater to greatly extend range. **3.** If desired you can connect Private Patch V to the MIC and speaker jack of your radio. **NO INTERNAL CONNECTIONS ARE REQUIRED.** Control is maintained automatically with built-in dial tone detection, busy signal detection and fully programmable activity and time out timers. An optional electronic voice delay board eliminates first word clipping with slow switching radios.

3. DUPLEX PATCH

Select duplex mode when connecting Private Patch V to your existing repeater or duplex base station. Many features including semi-duplex privacy mode are user programmable. The mobile is in full control at all times.

4. REPEATER CONTROLLER

Private Patch V will convert any receiver and transmitter into an outstanding performing repeater with duplex autopatch. Features such as repeater on/off code, hangtime, activity timer time, CW ID interval etc. are fully user programmable. Private Patch V is the right choice for your club system.

Private Patch V is a totally new concept in automatic phone patches. A built-in keyboard and menu driven display allow you to customize all modes, features, and functions specifically to *your application.*

Private Patch V can be a sampling patch today. A VOX patch tomorrow. And a repeater controller next year!

You may never need another patch again.

COMPARE THESE FEATURES . . .

- 90 phone number autodialer
- Last number recall
- Regenerated tone pulse dialing
- Toll restrict, 1st and 2nd digit restrict, prefix lockout and digit counting
- 1-5 digit connect/disconnect code
- 2-5 digit secret toll override code
- User programmable CW ID
- Remote hook flash
- Auto disconnect on dialtone/busy signals
- Telephone remote base
- Remote controlled relay (relay optional)
- Lightning protected

Call or write today for your FREE brochure.



CONNECT SYSTEMS INC.

23731 Madison St. Torrance, CA 90505
Phone: (213) 373-6803

AMATEUR ELECTRONIC SUPPLY: Milwaukie OR • WIL WICKLIFFE: Ft. Lauderdale FL • Clearwater FL • Las Vegas NV • BARRY ELECTRONICS CORP.: New York NY • ERICKSON COMMUNICATIONS: Chicago IL • HAM RADIO OUTLET: Anaheim CA, Burlingame CA, Oakland CA, Phoenix AZ • San Diego CA, Van Nuys CA, Atlanta GA • HENRY RADIO: Los Angeles CA • INTERNATIONAL RADIO SYSTEMS: Miami FL • JUNS ELECTRONICS: Culver City CA • MADISON ELECTRONICS SUPPLY: Houston TX • MIAMI RADIO CENTER CORP.: Miami FL • MIKES ELECTRONICS: Ft. Lauderdale, FL • N&G DISTRIBUTING CORP.: Miami FL • OMNI ELECTRONICS: Laredo TX • PACE ENGINEERING: Tucson AZ • THE HA! STATION: Evansville IN • VALLEY RADIO CENTER: Harlingen TX • CANADA—COM-WEST RADIO SYSTEMS, LTD.: Vancouver BC

KENWOOD

...pacesetter in Amateur Radio

THE FIRST
144/220 MHz
Dual Bander!

Double Take!



ACTUAL SIZE FRONT PANEL

TM-621A/721A

144/220 and 144/450 MHz FM Dual Bander

Once again, Kenwood brings you another Dual Bander! The TM-621A is the first 144/220 MHz FM Dual Bander. The Kenwood TM-621A and TM-721A (144/450 MHz) re-defines the original Kenwood "Dual Bander" concept. The wide range of innovative features includes a dual channel watch function, selectable full duplex operation, 30 memory channels, extended frequency coverage, large multi-line dual digital LCD displays, programmable scanning, and more.

- **Extended receiver range** (138.000-173.995 MHz) on 2 m, 70 cm coverage is 438.000-449.995 MHz. 1-1/4 m coverage is 215-229.995 MHz. (Specifications guaranteed on Amateur bands only. Two meter transmit range is 144-148 MHz. Modifiable for MARSSCAD Permits required.)
- **Separate frequency display for "main" and "sub-band"**
- **Call channel function** A special memory channel for each band stores frequency, offset, and sub-tone of your favorite channel. Simply press the CALL key, and your favorite channel is selected!

Optional Accessories

- **RC-10** Multi-function handset/remote controller
- **PS-430** Power supply
- **TSU-6** CTCSS decode unit
- **SW-100B** Compact SWR/power/volt meter
- **SV-200B** Deluxe SWR/power meter
- **SWT-1** 2 m antenna tuner
- **SWT-2** 70 cm antenna tuner
- **SP-40** Compact mobile speaker
- **SP-50B** Deluxe

- **30 multi-function memory channels.** 14 memory channels and one call channel for each band store frequency, repeater offset, CTCSS, and reverse. Channels "A" and "B" establish upper and lower limits for programmable band scan. Channels "C" and "d" store transmit and receive frequencies independently for "odd splits".
- **45 Watts on 2 m, 35 watts on 70 cm. 25 watts on 1-1/4 m.** Approx. 5 watts low power.
- **Automatic Band Change (A.B.C.)** Automatically changes between main and sub-band when a signal is present.
- **Dual watch function allows VHF and UHF receive simultaneously.**
- **Programmable memory and band scanning, with memory channel lock-out and priority watch function.**
- **Balance control and separate squelch controls for each band.**

- **Dual antenna ports.**
- **TM-621A has auto offset.**
- **Full duplex operation.**
- **CTCSS encode/decode selectable from front panel** or UP/DWN keys on microphone. (Encode built-in, optional TSU-6 needed for decode.)
- **Each function key has a unique tone for positive feedback.**
- **Illuminated front panel controls and keys.**
- **16 key DTMF mic. included.**
- **Handset/remote control option (RC-10).**
- **Frequency (dial) lock.**
- **Supplied accessories:** 16-key DTMF hand mic., mounting bracket, DC cable.

Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications, features, and prices are subject to change without notice or obligation.



TM-721A shown with optional RC-10.

- mobile speaker
- **PG-2N** DC cable
- **PG-3B** DC line noise filter
- **MC-60A, MC-80, MC-85** Base station mics.
- **MA-4000** Dual band 2 m/70 cm mobile antenna (mount not supplied)
- **MB-11** Mobile bracket
- **MC-43S** UP/DWN hand mic.
- **MC-48B** 16-key DTMF hand mic.

KENWOOD

KENWOOD U.S.A. CORPORATION
2201 E. Dominguez St., Long Beach, CA 90810
P.O. Box 22745, Long Beach, CA 90801-5745

HAM RADIO

FEBRUARY 1989

volume 22, number 2

T. H. Tenney, Jr., W1NLB
publisher
and editor-in-chief

Terry Northup, KA1STC
managing editor

Marty Durham, NB1H
technical editor

Robert D. Wilson, WA1TKH
consulting editor

Tom McMullen, W1SL
Joseph J. Schroeder, W9JUV
Alfred Wilson, W6NIF
associate editors

Susan Shorrock
production editor

Peggy Tenney, KA1QDG
copy editor

Beth McCormack
editorial assistant

editorial review board

Peter Bertini, K1ZJH
Forrest Gehrke, K2BT
Michael Gruchalla, P.E.
Bob Lewis, W2EBS
Mason Logan, K4MT
Vern Riportella, WA2LQQ
Ed Wetherhold, W3NQN

publishing staff

J. Craig Clark, Jr., N1ACH
assistant publisher

Henry S. Gallup, N1GCF
director of advertising sales

Dorothy Sargent, KA1ZK
advertising production manager

Susan Shorrock
circulation manager

Therese Bourgault
circulation

Phil Alix, N1FPX
traffic manager

Maribeth Buchanan
HAM RADIO Bookstore

Hans Evers, PA0CX
cover

Bill Burtis
cover photo

HAM RADIO Magazine is published monthly by
Communications Technology, Inc.
Greenville, New Hampshire 03048-0498
Telephone: 603-878-1441

subscription rates

United States:

one year, \$22.95; two years, \$38.95; three years, \$49.95

Europe (via KLM air mail), \$40.00

Canada, Japan, South Africa and other countries (via surface mail),
one year, \$31.00; two years, \$55.00; three years, \$74.00

All subscription orders payable in U.S. funds, via international
postal money order or check drawn on U.S. bank

international subscription agents: page 88

Microfilm copies are available from
Buckmaster Publishing
Mineral, Virginia 23117

Cassette tapes of selected articles from *HAM RADIO*
are available to the blind and physically handicapped
from Recorded Periodicals,
919 Walnut Street, Philadelphia, Pennsylvania 19107

Copyright 1988 by Communications Technology, Inc.
Title registered at U.S. Patent Office

Second-class postage paid
at Greenville, New Hampshire 03048-0498
and at additional mailing offices
ISSN 0148-5989

Send change of address to *HAM RADIO*
Greenville, New Hampshire 03048-0498

FEATURES

10 A \$40 Digital Voice Storage Id'er

Carl Lyster, WA4ADG

18 Ham Radio Techniques: "Son of Woodpecker"

Bill Orr, W6SAI

24 High-Impedance Rotary Step Attenuator

John Pivnichny, N2DCH

20 The L-Match A Useful Tool for Improving Your SWR

Robert C. Cheek, W3VT

42 VHF/UHF World: DX Records on 50 MHz and Above: part 2

Joe Reisert, W1JR

59 Antenna Array Patterns with a Personal Computer

Dennis D. King, KC7MT

67 A 220-MHz 9600-Baud Data Radio System for Packet

Fred B. Cupp, W2DUC

82 Practically Speaking: Antenna System Instruments

Joe Carr, K4IPV

94 The Weekender: A Transmit Timer for the KPC-2

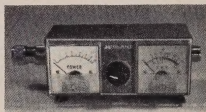
Peter J. Bertini, K1ZJH

104 Elmer's Notebook: FETs — the Other Transistors

Tom McMullen, W1SL



W1JR, page 42



K4IPV, page 82



**THE
WEEKENDER**
N2DCH, page 24
K1ZJH, page 94

See page 17 for the winners of
December's handheld radio
contest.

DEPARTMENTS

Backscatter	4	Flea Market	98
Comments	6	New Products	101, 103, 105
Ham Notebook	54	Ham Mart	102
DX Forecaster	91	Advertiser's Index	110
Short Circuit	96	Reader Service	110



BACKSCATTER

Glasnost and Amateur Radio

It's fascinating how the "Iron Curtain" has opened in the past few months. First a group of Russian and Finnish hams operated from Mal'j Vysotskij Island; then jamming of several shortwave broadcasters stopped. Now, there's the amazing story of how the International Amateur Radio Network (IARN) was able to get two operators and \$10,000 worth of radio gear into the Soviet Union to help with the Armenian relief effort! This would have been unheard of 10 years ago. Today, it could signal the beginning of a new era of cooperation between the USSR and the rest of the world.

Recently, the ARRL participated in assembling portable battery-operated packet stations. The first complete stations were shipped to Moscow on December 19th. The RSGB's Raynet Organization activated its International Emergency Center, and has been cooperating with the British Red Cross and the UK Overseas Development Agency. We thought you'd enjoy the following piece as a sample of some of the ham activities you'll read more about shortly.

(Thanks Westlink and W9ELR)
de N1ACH

A Christmas Present To Armenia

On December 14, 1988 the IARN, an all-volunteer Amateur Radio organization, asked for people to go to Moscow and help the Soviet Amateur Radio Operators set up much-needed radio circuits between earthquake-ravaged Armenia and the rest of the world. Nearly \$10,000 of sophisticated radio communication equipment had been donated by various manufacturers and charitable organizations for this purpose.

Charles Sheffer, KJ4TY, of Apalachicola, Florida and I flew to Cleveland, Ohio to meet with a handful of dedicated Amateur Radio operators (headed by Dave Speltz, KB1PJ) to coordinate and finalize plans for this humanitarian effort.

Glenn Baxter, K1MAN, of Belgrade Lakes, Maine, head of the IARN, had obtained permission from the Soviet Union for this person-to-person assistance. This was a tremendous breakthrough between two great powers.

KJ4TY and I finally left JFK Airport in New York on December 17th. Aeroflot, the U.S.S.R.'s airline, had agreed to fly us (and all of our radio equipment) to Moscow, at no expense. The Aeroflot personnel were very helpful and put all the radio equipment aboard the plane as our personal baggage.

After an 8-hour flight, we arrived in Moscow and were met at the airport by Soviet officials and representatives of the Soviet Union Amateur Radio community. The officials helped us through customs, waiving all red tape so we could enter the country. We were greeted cordially and, after the proper introductions, were taken to our hotel. During our stay, we had a car, driver, and an interpreter at our disposal.

We eagerly awaited an appointment with the local Amateur Radio organization to finalize plans for assisting them in setting up the emergency communications links between Armenia, Moscow, and the rest of the world.

On our third day in Moscow, we were called into a meeting and told that we must leave the following day. Officials explained that the Aeroflot had reservations booked for nearly a year. They also explained that there were so many foreign assistance personnel in Armenia already, that it was beginning to interfere with the total relief program. They felt that their own Amateur Radio operators could set up the necessary communication links. Having met with some of the local Amateurs, we heartily agreed that they could do the job.

Early the next morning, Soviet officials picked us up at our hotel and drove us to the airport. We left all the radio equipment for use in the emergency networks.

The Soviets seemed extremely grateful for the equipment. They gave us a parting gift and thanked us time and time again for our efforts.

Amateur Radio operators worldwide had been rooting for us, and had assisted with communications in preparation for this trip. This was the first time that anything of this magnitude had been attempted with the Soviet Union. As our efforts were purely humanitarian, we feel that a great stride forward has been made for closer and peaceful cooperation between two great countries.

Our Christmas present to the Soviet Union will prove, in a small way, that people on this planet can work together for a better, more peaceful world.

Al Vayhinger, W9ELR

KENWOOD

...pacesetter in Amateur Radio

Good
for Satellite
Digital QSOs

Matching Pair

TS-711A/811A VHF/UHF all-mode base stations

Look for
FUJI
and
PHASE III-C

The TS-711A 2 meter and the TS-811A 70 centimeter all mode transceivers are the perfect rigs for your VHF and UHF operations. Both rigs feature Kenwood's new Digital Code Squelch (DCS) signaling system. Together, they form the perfect "matching pair" for satellite operation.

• Highly stable dual digital VFOs.

The 10 Hz step, dual digital VFOs offer excellent stability through the use of a TCXO (Temperature Compensated Crystal Oscillator).

• Large fluorescent multi-function display.

Shows frequency, RIT shift, VFO A/B, SPLIT, ALERT, repeater offset, digital code, and memory channel.

• 40 multi-function memories.

Stores frequency, mode, repeater offset, and CTCSS tone. Memories are backed up with a built-in lithium battery.



• Versatile scanning functions.

Programmable band and memory scan (with channel lock-out). "Center-stop" tuning on FM. An "alert" function lets you listen for activity on your priority channel while listening on another frequency. **A Kenwood exclusive!**

• RF power output control.

Continuously adjustable from 2 to 25 watts.

• Automatic mode selection.

You may select the mode manually using the front panel mode keys. Manual mode selection is verified in International Morse Code.

• All-mode squelch.

• High performance noise blanker.

• Speech processor.

For maximum efficiency on SSB and FM.

• IF shift.

• "Quick-Step" tuning.

Vary the tuning characteristics from "conventional VFO feel" to a stepping action.

• Built-in AC power supply.

Operation on 12 volts DC is also possible.

• Semi break-in CW, with side tone.

• VS-1 voice synthesizer (optional)

More TS-711A/811A information is available from authorized Kenwood dealers.



Optional accessories.

- IF-10A computer interface
- IF-232C level translator
- CD-10 call sign display
- SP-430 external speaker
- VS-1 voice synthesizer
- TU-5 CTCSS tone unit
- MB-430 mobile mount
- MC-60A, MC-80, MC-85 deluxe desk top microphones

- MC-48B 16-key DTMF, MC-43S UP/DOWN mobile hand microphones
- SW-200A/B SWR/power meters:
SW-200A 1.8-150 MHz
SW-200B 140-450 MHz
- SWT-1 2-m antenna tuner
- SWT-2 70-cm antenna tuner
- PG-2U DC power cable

KENWOOD

KENWOOD U.S.A. CORPORATION
2201E, Dominguez St., Long Beach, CA 90810
P.O. Box 22745, Long Beach, CA 90801-5745

Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications and prices are subject to change without notice or obligation.



COMMENTS

Attracting or discouraging newcomers

Dear HR

Your editorial and some letters in the August issue raised some good points why Amateur Radio still has problems attracting newcomers, but I feel the major reasons were not really addressed.

Forget the old excuse about ham equipment costing too much today—gear has always been too expensive for younger amateurs! My first rig was a Heath HW-16, which ran for a little over \$100. That might sound like a terrific bargain, but \$100 was my parents' monthly mortgage payment.

I think you can make a good case that new hams today have an easier time of equipping their stations than newcomers did two decades ago. There are plenty of used rigs around from the late 1970s, which do an excellent job on CW and SSB and can be had for well under \$500. These are tube rigs, to be sure, but it doesn't take long to properly tune one up when changing bands. You can also get on 220 or 10 with a new rig for well under \$500. Cost clearly isn't the problem.

Is there really any demand at all for a "bare bones" transceiver at about \$500? The folks at Ten-Tec have marketed a very similar rig, the Argosy, for several years with only modest sales; I hear rumors that it's been discontinued. In the August issue, W1FB asked what happened to the concept of high volume and low per-unit profit. What happened is that there's no "high volume" to speak of today in the

ham radio market — by its very nature, it's a low volume, high markup business. Using W1FB's reasoning, *HAM RADIO* could really increase its circulation by lowering the subscription price to \$5 per year! If W1FB thinks there's money to be made by manufacturing a \$500 transceiver, he should do it and get rich. (Or go broke...)

The problem is not a lack of technical interest or smarts among young people. If you're one of those rare hams with an interest in computing above the Commodore-64 level, you've seen how rapidly teenagers can master C and assembly programming and discuss the intricacies of the MicroChannel data bus. They're learning and having fun, and being a computer whiz is "cool" in a lot of circles. Many of these youngsters would have been attracted to Amateur Radio in the past. (As an aside, the microcomputer industry has quite a few former Amateurs who left the hobby for computing. The most famous of these is Steve Wozniak, the co-founder of Apple Computer.)

So why are we not seeing the expected influx of newcomers from Novice enhancement? Consider the following:

1. Radio is no longer something mysterious or exciting. This is the era of instant worldwide communications by satellite. Even in the mid-1960s, the idea of being able to talk to someone thousands of miles away seemed like science fiction, and there was a natural curiosity as to how such an amazing feat could be accomplished. Youngsters today have grown up with live television from the moon, dialing to foreign countries, and cordless telephones. Radio is an accepted fact of their lives, not an exciting innovation. They have little reason to get excited about owning or operating a radio station. (If they only want to engage in aimless chatter by radio with a group of friends, there's always CB.)

It's interesting to look at some old technical magazines in a good library.

At the turn of the century, electricity was the big thing and entire magazines were devoted to experiments with it. As electricity became commonplace, interest in experimenting with it died out — and so did the magazines. We're doubtlessly seeing a similar phenomenon (hopefully to a smaller degree) with radio.

2. Amateur radio has been "curmudgeonized." In the August issue, W1FB wrote that "...a large portion of the fraternity consists of retirees who must exist on fixed incomes." That's obvious to anyone who listens to the General portion of 75 meters. Suppose you're a teenager. Would you want to talk to a bunch of people old enough to be your grandfather? I'm 35 and have a hard time finding someone interesting stateside to have a ragchew with. Can you imagine what it must be like for someone who's 15? Moreover, I have a feeling that a lot of older (in a mental, if not chronological, sense) Amateurs dislike youngsters. There's a letter in the August issue complaining about a generation of "gimmies" who "...are accustomed to essentially getting everything that they want." I don't think I'd have much to say to such a person on the air, and I doubt if many young potential Amateurs would either.

3. A lot of Amateurs don't want growth. This is Amateur Radio's dirty little secret. I recently spoke with a non-ham who had been instrumental in producing the licensing materials now sold through Radio Shack stores. He attended Ham-Com in Dallas and sat in on a session about attracting newcomers. He was shocked at the number of hams there who were quite vocal in their desire for fewer, not more, Amateurs. I told him he should listen to our bands sometime!

4. The ham industry isn't involved as it must be for its own future. One of my hobbies is scuba diving. Go into a dive shop and ask about becoming certified. They won't let you go until you've signed up for a course! Now walk into your local ham dealer and ask

KENWOOD

...pacesetter in Amateur Radio

DX-celence!

#1 Rated HF!



TS-940S

Competition class HF transceiver

TS-940S—the standard of performance by which all other transceivers are judged. Pushing the state-of-the-art in HF transceiver design and construction, no one has been able to match the TS-940S in performance, value and reliability. The product reviews glow with superlatives, and the field-proven performance shows that the TS-940S is “The Number One Rated HF Transceiver!”

• 100% duty cycle transmitter.

Kenwood specifies transmit duty cycle **time**. The TS-940S is guaranteed to operate at full power output for periods **exceeding one hour**, (14.250 MHz, CW, 110 watts.) Perfect for RTTY, SSTV, and other long-duration modes.

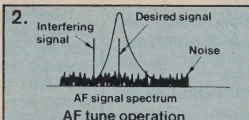
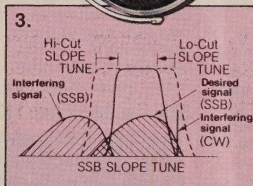
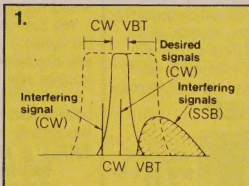
• First with a full one-year limited warranty.

• **Extremely stable phase locked loop (PLL) VFO.** Reference frequency accuracy is measured in **parts per million!**

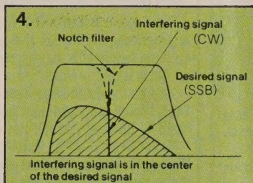
Optional accessories:

- AT-940 full range (160-10m) automatic antenna tuner
- SP-940 external speaker with audio filtering
- YG-455C-1 (500 Hz), YG-455CN-1 (250 Hz), YK-88C-1 (500 Hz) CW filters;
- YK-88A-1 (6 kHz) AM filter
- VS-1 voice synthesizer
- SO-1 temperature compensated

Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications, features, and prices are subject to change without notice or obligation.



- The AF TUNE function reduces interfering signals and white noise
- This function should only be used during operation in the CW mode



1) **CW Variable Bandwidth Tuning.** Vary the passband width continuously in the CW, FSK, and AM modes, without affecting the center frequency. This effectively minimizes QRM from nearby SSB and CW signals.

2) **AF Tune.** Enabled with the push of a button, this CW interference fighter inserts a tunable, three pole active filter between the SSB/CW demodulator and the audio amplifier. During CW QSOs, this control can be used to reduce interfering signals and noise, and peaks audio frequency response for optimum CW performance.

3) **SSB Slope Tuning.** Operating in the LSB and USB modes, this front panel control allows independent, continuously variable adjustment of the high or low frequency slopes of the IF passband. The LCD sub display illustrates the filtering position.

4) **IF Notch Filter.** The tunable notch filter sharply attenuates interfering signals by as much as 40 dB. As shown here, the interfering signal is reduced, while the desired signal remains unaffected. The notch filter works in all modes except FM.

• **Complete all band, all mode transceiver with general coverage receiver.** Receiver covers 150 kHz-30 MHz. All modes built-in: AM, FM, CW, FSK, LSB, USB.

• **Superb, human engineered front panel layout for the DX-minded or contesting ham.** Large fluorescent tube main display with dimmer; direct keyboard input of frequency; flywheel type main tuning knob with optical encoder mechanism all combine to make the TS-940S a joy to operate.

• **One-touch frequency check (T-F SET) during split operations.**

• **Unique LCD sub display indicates VFO, graphic indication of VBT and SSB Slope tuning, and time.**

• **Simple one step mode changing with CW announcement.**

• **Other vital operating functions.** Selectable semi or full break-in CW (QSK), RIT/XIT, all mode squelch, RF attenuator, filter select switch, selectable AGC, CW variable pitch control, speech processor, and RF power output control, programmable band scan or 40 channel memory scan.

- crystal oscillator
- MC-43S UP/DOWN hand mic.
- MC-60A, MC-80, MC-85 deluxe base station mics.
- PC-1A phone patch
- TL-922A linear amplifier
- SM-220 station monitor
- BS-8 pan display
- SW-200A and SW-2000 SWR and power meters
- IF-232C/IF-10B computer interface.

KENWOOD

KENWOOD U.S.A. CORPORATION
2201 E. Dominguez St., Long Beach, CA 90810
P.O. Box 22745, Long Beach, CA 90801-5745

MFJ TUNERS

Invest in the finest 3 KW roller inductor tuner money can buy with dummy load, new peak reading Meter and more...

The MFJ-989C is a compact 3 KW roller inductor tuner with a new peak reading Cross-Needle SWR/Wattmeter. The roller inductor lets you get your SWR down to absolute minimum.

With three continuously variable components -- two massive 6 KV capacitors and a high inductance roller inductor -- you get precise control over SWR and the widest matching range possible from 1.8-30 MHz.

You get a new lighted peak and average reading Cross-Needle SWR/Wattmeter with a new more accurate directional coupler.

You get a giant two core balun wound with teflon wire for balanced



MFJ-989C

\$349⁹⁵

lines and a 6-position antenna switch with extra heavy switch contacts.

You get a 50 ohm 300 watt dummy load for tuning your exciter, a tilt stand for easy viewing and a 3-digit turns counter plus a spinner knob for exact inductance control.

Its compact 10 1/2 x 4 1/2 x 1 1/2 inch cabinet slides right into your station.

The MFJ-989C is not for everyone.

However, if you do make the investment, you'll get the finest 3 KW tuner money can buy -- one that will give you a lifetime of use, one that takes the fear out of high power operation and one that lets you get your SWR down to absolute minimum.

MFJ's Best VERSA TUNER II



MFJ-949C
\$139⁹⁵

The MFJ-949C gives you more precise matches than any tuner that uses two tapped inductors. Why?

Because you get two continuously variable capacitors that give you infinitely more positions than the limited number on switched coils.

This gives you the precise control you need to get your SWR down to a minimum. After all, isn't that why you need a tuner.

You also get a dual range lighted Cross-Needle SWR/Wattmeter, 6-position antenna switch, 50 ohm 300 watt dummy load, balun for balanced lines and continuous 1.8-30 MHz coverage -- all in a compact 10x3x7 inch cabinet that fits right into your station.

With MFJ's best 300 watt tuner you get an MFJ tuner that has earned a reputation for being able to match just about anything -- on that is highly perfected and has years of proven reliability.

MFJ's smallest VERSA TUNER

MFJ-901B
\$59⁹⁵

The MFJ-901B is our smallest -- 5x2x6

inches -- and most affordable! 200 watt PEP Versa tuner -- when both your space and your budget is limited. Matches dipoles, vees, random wires, verticals, mobile whips, beams, balanced and coax lines continuously 1.8-30 MHz. Excellent for matching solid state rigs to linears. Efficient airwound inductor. 4:1 balun for balanced lines.

144/220 MHz VHF TUNERS

MFJ-920
\$49⁹⁵

MFJ-921
\$69⁹⁵

MFJ's newest VHF

tuners cover both 2 Meters and the new Novice 220 MHz bands. They handle 300 watts PEP and match a wide range of impedances for coax fed antennas. MFJ-921 has SWR/Wattmeter.



MFJ's Fastest Selling TUNER



The MFJ-941D is MFJ's fastest selling MFJ-941D 300 W PEP antenna tuner! Why?

\$99⁹⁵ Because it has more features than tuners costing much more and it matches exactly continuously from 1.8-30 MHz.

It matches dipoles, vees, verticals, mobile whips, random wires, balanced and coax lines.

SWR/Wattmeter reads forward/reflected power in 30 and 300 watt ranges. Antenna switch selects 2 coax lines, direct or through tuner, random wire/balanced line or tuner bypass. Efficient airwound inductor gives lower losses and more watts out. Has 4:1 balun. 1000 V capacitors. 10x3x7 inches.

MFJ's Mobile TUNER



MFJ-945C
\$79⁹⁵

Don't leave home without this mobile tuner! Have an uninterrupted trip as the MFJ-945C extends your antenna bandwidth and eliminates the need to stop, go outside and readjust your mobile whip.

You can operate anywhere in a band and get low SWR. You'll get maximum power out of your solid state or tube rig and it'll run cooler and last longer.

Small 8x2x6 inches uses little room. SWR/Wattmeter and convenient placement of controls make tuning fast and easy while in motion. 300 watts PEP output, efficient airwound inductor, 1000 volt capacitors. Mobile mount, MFJ-20, \$3.00.

2 KW COAX SWITCHES

MFJ-1702
\$19⁹⁵

MFJ-1702, \$19.95. 2-positions.

60 dB isolation at 450 MHz.

Less than .2 dB loss.

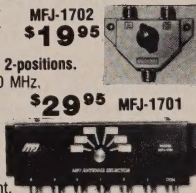
SWR below 1:1.2.

MFJ-1701, \$29.95.

6-positions. Unsurpassed

positions grounded.

For desk or wall mount.



MFJ's 1.5 KW VERSA TUNER III



For a few extra dollars, the MFJ-962C lets you use your barefoot rig
\$199⁹⁵ now and have the capacity to add

1500 watt PEP linear amplifier later.

Two continuously variable 6 KV capacitors give you precise control for getting your SWR down to a minimum. And lots of inductance gives you the widest matching range possible.

You can read both peak and average power with the lighted 2-color Cross-Needle SWR/Wattmeter. A new directional coupler gives you more accurate readings over a wider frequency range.

Has 6-position ceramic antenna switch and a teflon wound two-core balun with ceramic feedthrough insulators for balanced lines. 10 1/2 x 4 1/2 x 1 1/2 inch.

MFJ's Random Wire TUNER

MFJ-16010
\$39⁹⁵

You can operate all bands anywhere with any transceiver when you let the MFJ-16010 turn any

random wire into a transmitting antenna. Great for apartment, motel, camping operation. Tunes 1.8-30 MHz. Handles 200 watts. Ultra compact 2x3x4 in.

MFJ artificial RF ground

\$79⁹⁵ MFJ-931



You can create an artificial RF ground and eliminate RF "bites", feedback, TVI and RFI when you let the MFJ-931 resonate a random length of wire and turn it into a tuned counterpoise. The MFJ-931 also lets you electrically place a far away RF ground directly at your rig -- no matter how far away it is -- by tuning out the reactance of your ground connection wire.

ORDER ANY PRODUCT FROM MFJ AND TRY IT -- NO OBLIGATION. IF NOT SATISFIED RETURN WITHIN 30 DAYS FOR A NO-HASSLE REFUND (less shipping).
• One year unconditional guarantee • Add \$5.00 each shipping/handling • Call or write for free catalog, over 100 products.

MFJ

MFJ ENTERPRISES, INC.

Box 494, Miss. State, MS 39762

FOR YOUR NEAREST DEALER OR TO ORDER

800-647-1800

Call 601-323-5869 in Miss. and outside continental USA. Telex 53-4590 MFJ STKV.
In CANADA call TEXPRO 416-332-5944.

MasterCard

VISA

MFJ . . . making quality affordable

about getting licensed. You might be referred to a local club.

The diving industry recognizes it has to take the initiative to train new divers, thereby increasing its customer base and assuring future profits. Major manufacturers and local ham dealers must adopt a similar attitude instead of leaving it up to an overloaded ARRL and local clubs.

5. We need some form of code-free license. Actually, this would merely restore an old tradition to Amateur Radio, since many (if not most) people who obtained a Conditional or Technician license prior to 1976 never really learned CW. (Don't take my word on it; look at the results of those the FCC called in for re-testing!) What is so terrible about substituting stiffer theory for CW above 144 MHz, or maybe having a modified form of the old Novice ticket authorizing FM on 220 but with a expiration limit of one or two years? A no-code license is not a panacea for slow growth, but it would help.

The most interesting thing about the idea of a code-free license is the hypocrisy it brings out in the Amateur ranks. Ever notice how many of the strongest defenders of the code don't have the Extra? If CW is that essential (and easy), may I humbly suggest they take some of the energy they use opposing no-code and get their CW speed up to 20 WPM?

I got interested in Amateur Radio early enough to enjoy Rod Newkirk's DX column in *QST*. He ended one column devoted to increasing QRM on the bands by remarking that we must have more Amateurs. Our choice, in Rod's terrific phrase, was either QRM or QRT. His words are just as applicable today. I want to enjoy Amateur Radio for several more years. But it will not be possible without a sustained flow of younger recruits in the ranks and changes in the structure of the service. We need realistic thinking, not chimeras or warm nostalgia.

Harry Helms, AA6FW,
San Diego, California 92126

Applause for Net Control Operators

Dear HR

As I sit here, for the third day, monitoring the FCC Emergency Frequencies of 14.325 and 14.275, I am appalled at what I hear. There are not only the overly enthusiastic hams who try to assist when no assistance is asked for by Net Control, but those who intentionally and with malice cause interference. Then there are those who think that their questions and messages are the most important ones and should be answered without regard to, and before all others.

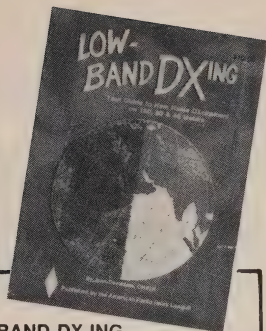
For those who fall into the category of causing malicious interference there is no solution other than trying to identify them and suspend their licenses. If they think that they can not be identified they are mistaken. Fellow Amateurs, let's do our thing and self-police the bands.

As to the over enthusiastic hams, please follow the instructions of the net control operator. It is obvious from monitoring the nets that the net control operators not only know what they are doing, but are doing an outstanding job under the circumstances. Let's NOT add to their problems.

As far as those who have health and welfare (H & W) traffic, remember LIFE and DEATH traffic M U S T come first. I also have H & W traffic and have a deep interest in seeing that it gets into the system. However, I wait and follow the instructions of the Net Control.

Having been an Amateur for over 25 years and a net control operator for a good number of years, while serving in the military, I know how demanding the job is. My hat off to all those who served as net control operators during the Hurricane Gilbert emergency. Thank you for your outstanding devotion to Amateur Radio.

David L. Schwein, N4OBU,
Sebring, Florida 33870



LOW BAND DX-ING COMPUTER PROGRAMS

by John Devoldere, ON4UN, for
Apple IIe/c, MS-DOS, Commodore
C-128 Apple Macintosh and Kaypro
CPM Computers

Here's a collection of 30 super programs written by ON4UN. Just about every interest or need is covered—from antenna design and optimization to general operating programs. Antenna programs include: shunt and series input L network design, feedline transformer, shunt network design, SWR calculation, plus 11 more! General Ham programs include: sunrise/sunset, great circle distances, grayline, vertical antenna design program, sunrise calendar plus 9 more! Phew. When you sit down to use these programs you'll be amazed at what you have. The best value in computer software available today. © 1986.

- ☐ UN-Apple IIe/IIc \$39.95 ea.
- ☐ UN-MS (MS-DOS) \$39.95 ea.
- ☐ UN-CPM/Kaypro \$39.95 ea.
- ☐ UN-C-128 (COMMODORE) \$39.95 ea.
- ☐ UN-MAC (MACINTOSH) \$49.95

LOW BAND DX'ING by John Devoldere ON4UN

Now Available! The new, 2nd edition of the definitive book on Low Band DX'ing. Based upon years of practical on-the-air experience, learn the secrets of how ON4UN has been so successful on the low bands. Extensive coverage is given to transmit and receive antennas with clear concise explanations and plenty of illustrations—dipoles, inverted V's, slopers, phased arrays and Beverages—they're all in this book. Also covered: propagation, transmitters, receivers, operating, software and an extensive Low Band bibliography. Going to be a best seller! Get yours today. © 1987 2nd Edition 200 pages

- ☐ AR-UN Softbound \$9.95

BUY'EM BOTH SPECIAL OFFER

Book & Software Reg. \$49.90
(\$59.90 for Mac)

Just \$44.90 (\$54.90 for Mac)

- ☐ UN-SO (specify computer) \$44.90
- ☐ UN-MSO Macintosh Special \$54.90

SAVE \$5

Please enclose \$3.50 shipping & handling

**HAM BOOKSTORE
RADIO**

GREENVILLE, NH 03048

603-878-1441

A \$40 DIGITAL VOICE STORAGE ID'ER

By Carl Lyster, WA4ADG, 4412 Damas Road, Knoxville, Tennessee 37921

Use this device to reproduce up to 6.4 seconds of voice

I have designed and built a digital voice storage device capable of reproducing up to 6.4 seconds of human voice. The basic design can be expanded to provide longer and/or multiple messages.

Theory of operation

To understand digital voice storage, first assume that you want to record a 1000-Hz, zero to 5-volt sine wave. If you were to "freeze" the sine wave for an instant, you would observe a DC voltage somewhere between zero and 5 volts. You'd record the readings in a notebook and plot them on a piece of graph paper. Then you would "release" the sine wave and freeze it again 1/10,000th of a second later. The recording and plotting of this new value would show it to be slightly different in amplitude. If you were to repeat this process 10,000 times, you would have a written record composed of 10,000 voltage data points representing 1000 cycles of the sine wave, and a graph to prove it! Now try the experiment using real world electronics to accomplish the same results.

In place of a voltmeter, use an analog-to-digital converter (ADC) chip — an IC that measures a DC voltage and converts it to a binary number. Store the data points on some RAM memory chips (instead of in a notebook) and use a quartz crystal timebase to accurately time the 1/10,000th of a second sampling intervals. Before running the experiment, make one last change. This time try sampling the output of an amplified microphone instead of recording a sine wave.

Speak into the microphone until you use all of the RAM storage space. You now have a digitized human voice stored in the RAM memory. Program a ROM

memory chip with the exact data contained in the RAM memory chips to make a permanent copy of the recorded voice. An *almost* indestructible voice recording is stored in the ROM memory chip!

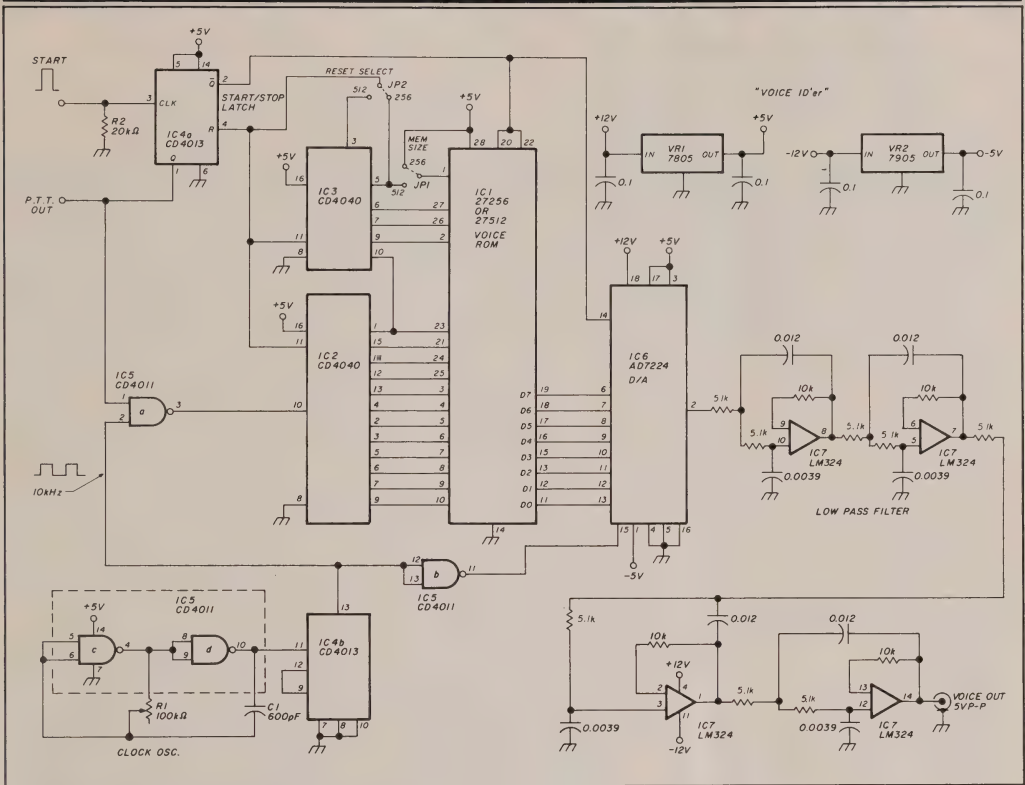
How do you recreate the voice stored in ROM? Retrieve the data from the ROM chip one data point at a time, with a spacing of exactly 1/10,000th of a second between data points. Feed each data point one after the other to an IC called a digital-to-analog converter (DAC). This chip takes a binary number representing a voltage and generates that voltage as its output. The data points entering the DAC cause a varying voltage output which is an exact duplication of the amplified microphone's output.

Now let's get to the ones and zeros of how this \$40 wonder works.

Technical description

Assume that the ROM chip has already been programmed with the desired voice passage (more on this later). Refer to **fig. 1**. IC4 is a CD 4013 dual flip flop. One flip flop is used as the start/stop latch. A positive going 5-volt input pulse toggles the Q output high and the Q bar output low. The Q output of the start/stop latch is used as an active high PTT signal to key external repeater logic. The Q output also gates the 10-kHz sampling clock at IC5a, and the Q bar signal enables the chip select lines of both the ROM and DAC. Two gates of IC5 (c and d) form an adjustable oscillator running at 20 kHz. Pot R1 sets the frequency of the oscillator and can be used as a "pitch adjustment" to fine tune the voice tone. The 20-kHz clock is divided by 2 in IC4b, which gives the required 10-kHz sampling clock and ensures a 50-percent duty cycle. The 10-kHz clock is inverted by IC5b and used to clock data into the DAC. The sequential addressing of the ROM is performed by two CD 4040 12-stage binary counters, IC2 and IC3. The gated 10-kHz clock pulses are fed to the first 12-stage counter, IC2. This counter addresses the first 12 bits (A0-A11) of the voice ROM. When IC2 overflows, a pulse is sent to the clock input

FIGURE 1



Complete schematic for the digitized voice ID'er.

of the next counter IC3, which handles the remaining address bits A12-A16.

There are two popular ROMs suitable for this circuit, the 27256 32K by 8 ROM and the 27512 64K by 8 ROM. At a sampling rate of 10 kHz the 27256 gives 3.2 seconds of voice; the 27512 delivers 6.4 seconds. These chips cost about \$7 and \$15, respectively.

The 27256 requires 15 address bits, A0-A14. The 27512 needs 16 bits, A0-A15, to address all memory locations. Two jumpers provided in the binary counter chain accommodate these differences. Jumper JP1 is connected to pin 1 of the ROM socket. If you use a 27256 ROM, you must select JP1 to provide a +5 volt level on pin 1 of the ROM. With a 27512, JP1 must apply counter address bit A15 to pin 1 of the ROM. The remaining jumper, JP2, controls the reset lines of the binary counters and the start/stop latch. This jumper selects the run time of the circuit. If you are using a 27256, you must connect JP2 to address bit A15 of the counter chain. A15 goes high after 3.2 seconds of run time. A high level on the reset lines clears the counters and the start/stop latch.

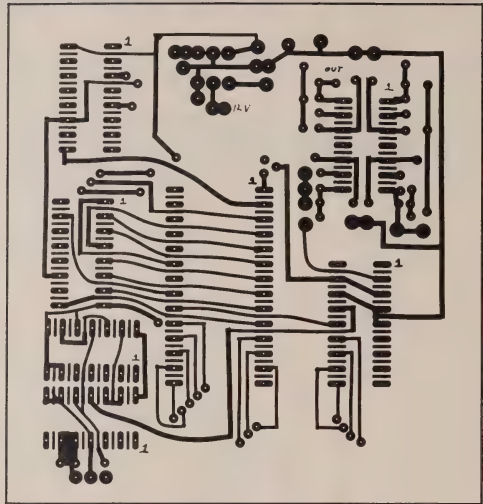
PARTS LIST

IC1	27256 or 27C256 300ns or faster EPROM-3.2 seconds of voice 27512 or 27C512 300ns or faster EPROM-6.4 seconds of voice
IC2	CD4040 binary counter
IC3	CD4040 binary counter
IC4	CD4013 dual flip flop
IC5	CD4011 quad nand gate
IC6	AD7234N DAC from Analog Devices Corp., Two Technology Way, Box 280, Norwood, Massachusetts 02062-0280
IC7	LM-324 quad op amp
VR1	7805 + 5 volt regulator
VR2	7905 - 5 volt regulator
R1	100-k 10-turn pot, top adjust
R2	20-k 1/4-watt carbon resistor
C1	500-pF (approximately) silver mica or disc capacitor
10 ea.	0.1- μ F 25-volt monolithic by-pass caps: 2 for VR1, 2 for VR2, and 1 by-pass cap from Vcc to ground for each IC
8 ea.	0.012- μ F 25-volt monolithic or mylar caps
4 ea.	0.0039- μ F 25-volt monolithic or mylar caps
5 ea.	5-1-k 1/4-watt carbon resistors
4 ea.	10-k 1/4-watt carbon resistors

When using a 27512, connect JP2 to A16 of the counter chain, which goes high after 6.4 seconds of run time.

As the counters address each of the ROMs' memory locations sequentially, the 8-bit data output is clocked into the DAC. The DAC produces a voltage at pin 2 proportional to the magnitude of the binary number data point output by the ROM. A value of zero gives zero volts

FIGURE 2



Foil-side pc layout of the circuit.

out, binary 10000000 gives 2.5 volts out and binary 11111111 gives 5 volts of output. This device can deliver 5 volts p-p of audio output, a substantial signal that needs to be reduced by a pot or fixed resistor network for most applications.

The power supply requirements are + 12 Vdc at 40 mA and - 12 Vdc at 15 mA. The + and - 12 Vdc supplies are used in the low-pass filters and are also regulated down to + and - 5 Vdc. The + 5 Vdc is used as the basic logic supply while the - 5 Vdc is used as a reference for the DAC. See **figs. 2-5** for pc board layouts and parts placement.

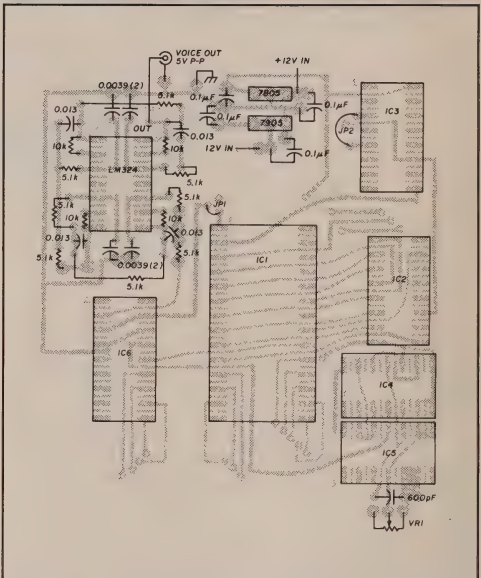
Bandwidth, sampling rate, and low-pass filters

When designing a digital voice storage device, pay careful attention to the interrelationship between audio bandwidth, digital sampling rate, and low-pass filter roll-off characteristics.

Audio bandwidth is usually determined by the frequency response of external electronics — in this case a typical narrowband FM voice channel. Assume a maximum frequency response of 5 kHz and you have just cast in concrete the minimum requirements for sampling rate and low-pass filter roll-off characteristics.

According to the Nyquist sampling theorem, a sine wave must be sampled a minimum of two times per cycle to be faithfully recreated. This project demonstrates this basic theorem. Because you've chosen 5 kHz as the maximum audio frequency, you must sample the signal at least 10,000 times per second and the low-pass filters

FIGURE 3



Component placement for the component side of the pc board.

must roll off at 5 kHz. Roll-off is usually measured in dB per octave; how much is needed?

When you violate the sampling theorem, a phenomenon known as aliasing results if you attempt to reproduce a frequency higher than the sampling rate allows. This makes the sine wave sound like a bucket of rusty bolts! Consequently, the low-pass filters must remove any detectable signal level in the frequency range above the Nyquist limit. The minimum detectable signal level is related to a property known as dynamic range, which is also expressed in dB and represents the amplitude range between the minimum and maximum reproducible levels.

This circuit uses an 8-bit DAC which gives 256 possible voltage level outputs with a maximum of 5 Vdc and a minimum of $5/256 = 0.0195$ Vdc output. The formula for figuring dynamic range in dB, $20 \log \text{out/in}$, shows that this circuit has $20 \log 5/0.0195 = 48$ dB of dynamic range. Figure the dB roll-off for the filter. Remember that the low-pass filters must attenuate the nonreproducible audio frequencies (in this case above 5 kHz) below the minimum signal level out (0.0195 Vdc). By convention, roll-off is chosen to produce a maximum reproducible output of one half the minimum reproducible level, or $0.0195/2 = 0.0097$ Vdc. The required roll-off is then $\text{dB} = 20 \log 5/0.0097 = 54$ dB.

My primary concerns for the active filter design I chose for this project were price and parts availability. I didn't

EIMAC Tubes Provide Superior Reliability at radio station KWAV — over 131,000 hours of service!



Ken Warren, Chief Engineer at KWAV reports that their 10 kW FM transmitter went on the air in November, 1972, equipped with EIMAC power tubes. The original tubes are still in operation after over 15 years of continuous duty!

Ken says, "In spite of terrible power line regulation, we've had no problems with EIMAC tubes. In fact, in the last two years, our standby transmitter has operated less than two hours!"

Transmitter downtime means less revenue. EIMAC tube reliability gives you *more* of what you need and *less* of what you don't want. More operating time and less downtime!

EIMAC backs their proven tube

reliability with the longest and best warranty program in the business. Up to 10,000 hours for selected types.



Quality is a top priority at EIMAC, where our 50-year charter is to produce long-life products. And our products are

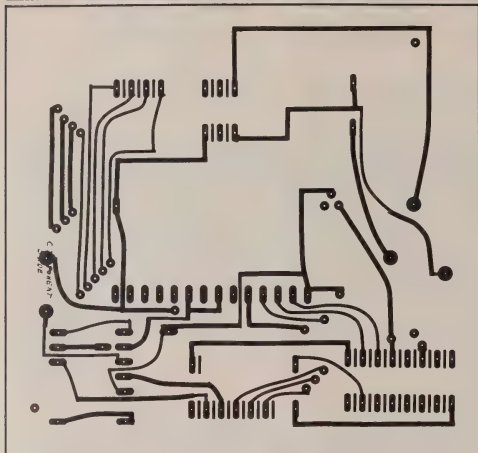
backed by the most comprehensive and longest warranty offered in the industry. Send for our free Extended Warranty Brochure which covers this program in detail: Write to:

Varian EIMAC
301 Industrial Way
San Carlos, CA 94070
Telephone: (415) 592-1221



varian  eimac

FIGURE 4



Component-side foil pattern for the circuit.

rule out performance compromises in order to keep the construction simple. Active filter design is somewhat of a "black art" at best, even with the help of *The Active Filter Cookbook*. Design work often requires oddball, impossible-to-locate resistor and capacitor values, which I refused to accept.

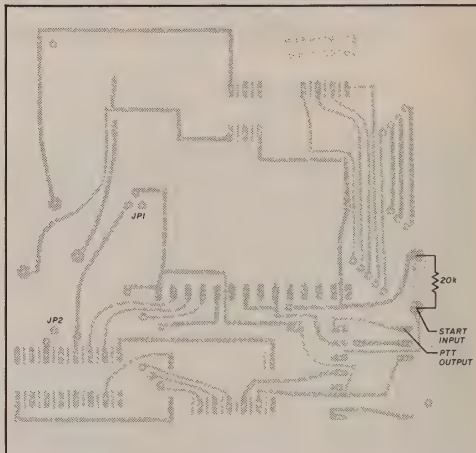
The filter I settled on may not suit the taste of a mathematical purist but, at the cost of \$1.00 each in parts, it can't be beat! I tested standard "off the shelf" 5-percent component values; they yielded very satisfactory results.

I needed a 54-dB roll-off, 5-kHz filter. The *Active Filter Cookbook* showed that a series of 5 second-order, equal component Sallen-key low-pass sections would fit the bill. Each second-order section gives 12 dB of roll-off. For economic reasons, I wanted to implement the entire filter on one LM-324 quad op amp. I designed a 4-section filter string which yielded about 48 dB per octave roll-off. The performance of the 48-dB filter was unacceptable so I changed the component values to the next higher 5-percent value. This, in effect, lowered the cut-off frequency of the filter below 5 kHz (a necessary compromise in order to give a 54-dB roll-off at 5 kHz). The final filter is pure simplicity: 2 resistor values, 2 capacitor values, and one 30-cent op amp!

Programming the voice ROM

You can program the voice ROM only with the aid of a personal computer. I plan to write another article on digital voice storage on the IBM PC. The hardware to implement voice storage on the PC is simple and provides the ability to directly program ROMs. The capability to store and retrieve voice on the PC offers a myriad of possibilities for automating the ham shack.

FIGURE 5



Foil-side component placement guide.

If you can't wait to find out how to program your ROM with the PC, I'll program it for you if you send me your EPROM, a good quality cassette recording of the voice passage you want programmed, and \$10 to cover postage and handling.

Modification of other ideas

This basic circuit has many uses beyond a repeater ID'er. You can prepare a canned message CQ caller for contests, create a beacon ID'er, or use the circuit as an instant touch-tone dialer for your favorite phone numbers. You can store any audio signal with frequency components under 5 kHz, including packet and SSTV transmissions. Because all the low-pass filter stages are DC coupled, the device can also store a serial TTL-level digital signal, provided that you keep the rate below 5K baud. I've used a similar unit to store digital test messages previously obtained from cassette tape in my professional work. Some useful changes you may wish to make include:

- Provide the ability to store two short messages in one ROM.
- Increase the length of storage time by adding more ROMs.

Both of these changes can be added easily. If you'd like to place two messages with a length of up to 3.2 seconds each into a 27512 ROM, simply select JP2 to provide a run time of 3.2 seconds and remove JP1. You can select two messages by way of an external ground applied to pin 1 of the ROM, if you place a 4.7-k resistor from pin 1 of the ROM to +5 volts. This divides the ROM space in half because pin 1 of the ROM is address bit A15. The 4.7-k pull-up resistor normally supplies a logic 1 to the A15 bit of the ROM; this selects the first message.

You'll be hard-pressed to beat the performance of Yaesu's new FT-411 handheld.



Let Yaesu's "next generation" handheld lighten your load!

Picking up where our popular FT-209R Series left off, the 2-meter FT-411 will amaze with its astounding array of features!

The brains of a base station. "Sophisticated operation" takes on new meaning in the FT-411. You get 49 memories, plus dual VFOs for quick band-hopping. Keyboard frequency entry. Automatic repeater shift. DTMF autodialer with ten memories of up to 15 digits each. *Built-in CTCSS encode/decode.* Selectable channel steps: 5/10/12.5/20/25 kHz. Programmable band scan with upper/lower limits. Selectable memory scan. And extended receive coverage of 140-174 MHz (MARS/CAP permit required for transmit on 140-150 MHz).

Not bad for a handheld measuring just 55(w) x 32(d) x 139(h) mm (the same size as our FT-23R Series HTs!)

Friendly operation. For operating convenience, the FT-411's keypad features a "do-re-mi" audible command verification. Both the display and keypad can be backlit (brightly!) for night operation at the push of a button. A rotary channel selector allows fast manual tuning. Or key in the frequency directly. Operate VOX (with YH-2 headset option). Plus you get a battery saver to conserve power while monitoring. And a (defeatable) automatic power-off feature that shuts down your radio if you forget to turn it off!

High power capability. The FT-411 comes equipped with the 2.5-watt, 600-mAh FNB-10 battery pack. Try our optional FNB-12 5-watt, 500mAh pack or tiny FNB-9 2.5-watt, 200-mAh pack. Or get 6 watts output by applying 13.8-volts DC from an external power supply.

Swap options with Yaesu's FT-23R Series. Our rugged best-seller's chargers, batteries, and microphones are fully compatible with the FT-411. The FT-23R is the perfect companion for the FT-411, and at a great price!

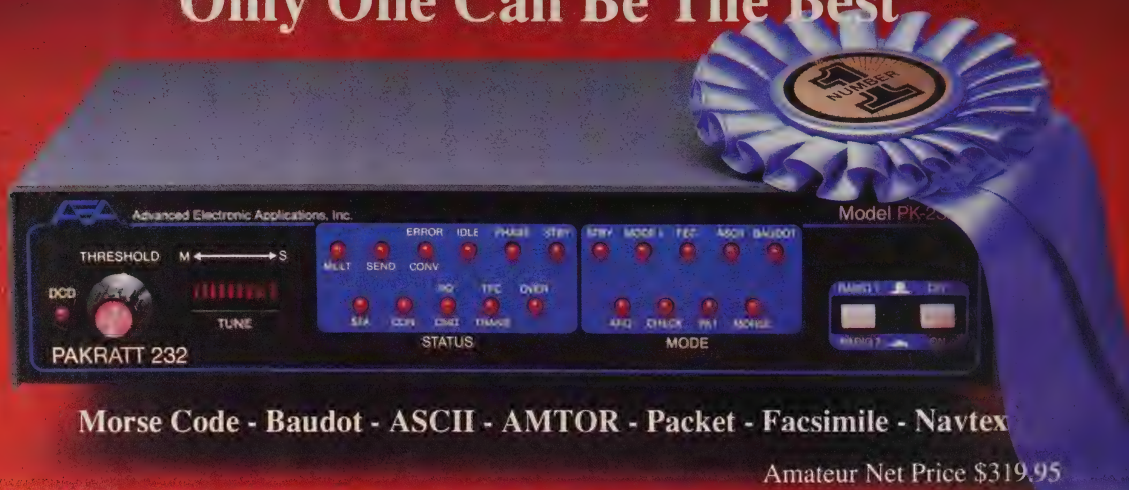
Try out an FT-411 today. Ask for it now at your local Yaesu dealer. Or call 1-800-999-2070 for a free brochure. And experience the legendary Yaesu HT performance!



YAESU

Others May Try to Imitate, But...

Only One Can Be The Best



Morse Code - Baudot - ASCII - AMTOR - Packet - Facsimile - Navtex

Amateur Net Price \$319.95

It's a lesson you learn very early in life. Many can be good, some may be better, but only one can be the best. The PK-232 is the best multi-mode data controller you can buy.

1 Versatility

The PK-232 should be listed in the amateur radio dictionary under the word Versatile. One data controller that can transmit and receive in six digital modes, and can be used with almost every computer or data terminal. You can even monitor Navtex, the new marine weather and navigational system. Don't forget two radio ports for both VHF and HF, and a no compromise VHF/HF/CW internal modem with an eight pole bandpass filter followed by a limiter discriminator with automatic threshold control.

The internal decoding program (SIAMtm) feature can even identify different types of signals for you, including some simple types of RTTY encryption. The only software your computer needs is a terminal program.



PC Pakratt Packet TX/RX Display



Facsimile Screen Display

2 Software Support

While you can use most modem or communications programs with the PK-232, AEA has two very special packages available exclusively for the PK-232....PC Pakratt with Fax for IBM PC and compatible computers, and Com Pakratt with Fax for the Commodore 64 and 128.

Each package includes a terminal program with split screen display, QSO buffer, disk storage of received data, and printer operation, and a second program for transmission/reception and screen display of facsimile signals. The IBM programs are on 5-1/4" disk and the Commodore programs are plug-in ROM cartridges.

3 Proven Winner

No matter what computer or terminal you plan to use, the PK-232 is the best choice for a multi-mode data controller. Over 20,000 amateurs around the world have on-air tested the PK-232 for you. They, along with most major U.S. amateur magazines, have reviewed the PK-232 and found it to be a good value and excellent addition to the ham station.

No other multi-mode controller offers the features and performance of the PK-232. Don't be fooled by imitations. Ask your friends, or call the local amateur radio store. We're confident the PK-232 reputation will convince you that it's time to order your very own PK-232.

Call an authorized AEA dealer today. You deserve the best you can buy, you deserve the PK-232.

Advanced Electronic Applications, Inc.

P.O. Box C-2160
Lynnwood, WA 98036
206-775-7373

AEA Brings you the Breakthrough!

[illegible]

Select the second message by grounding A15 from an external source like a switch. I've used this scheme several times for repeaters by placing the normal callsign in the first half and a burglar alarm message in the second. I control the choice of messages with a switch on the door of the repeater building.

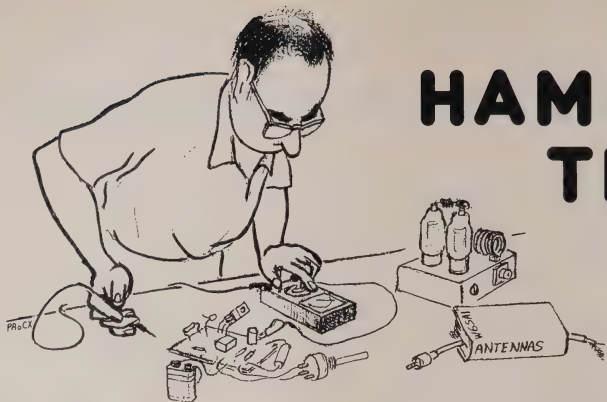
One 74HC138 octal decoder allows expansion of up to 8 ROMs; more than this will require extra buffering for the counter address bits. Using 27512 ROMs will give a maximum of 51.2 seconds of voice; 27256 ROMs will give you 25.6 seconds. When you use an extra decoder, the reset signal is derived from the next unused ROM select output of the decoder. For example, assume that you need a circuit containing 5 ROMs. The 74HC138 decoder has 8 outputs labeled from 0 to 7. Output 0 would go to the first ROM, output 1 to the second ROM, output 2 to the third, output 3 to the fourth, and output 4 to the fifth and last ROM. Output 5 of the decoder goes low after the last ROM is triggered, so output 5 must be

I hope I've helped give you a basic understanding of digital voice storage principles, and that you're eager to apply this device to your own projects. With a little ingenuity and logic you can modify the circuit to meet your own needs. Next time I'll discuss adding voice to the IBM series of computers and clones and the PROM programming procedure.

HAM RADIO

DECEMBER WINNERS

February 1989 17



HAM RADIO TECHNIQUES

Bill Orr, W6SAI

"Son of Woodpecker," or, more of what we don't need!

The good news is that the sunspot cycle is rapidly rising and the MUF is increasing. Ten meters is now a *real* DX band. The bad news is that the rising MUF has revealed some noxious interference in the Amateur bands, and it's bound to get worse before it gets better.

The interference I'm referring to is the "son of Woodpecker" radar signal in the 12-meter band. This buzzing source of interference is centered around 24.95 MHz and seems to be missile-tracking radar. It has a high repetition rate and sounds like a bumblebee. The signal peaks during the afternoon hours, indicating it's to the west of the Continental United States. When propagation is good, the buzzing noise blankets a large portion of the 12-meter band.

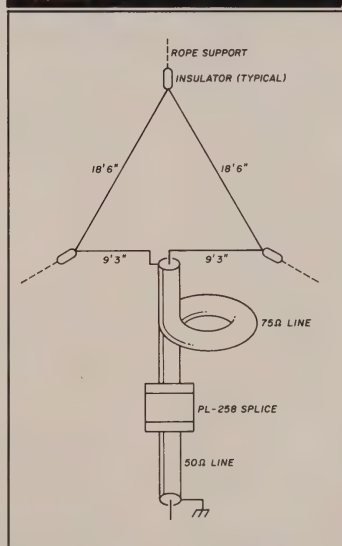
Direction-finding exercises have spotted the radar in the vicinity of Lake Baikal, and south of the city of Ulan-Ude, Siberia. I don't know if the radar runs continuously; I've only heard it at those times of the day when the MUF is high enough to support a propagation path between Central Asia and the United States. Unfortunately, the radar signal will become more disruptive as the MUF rises. And when the radar is absent, the "Woodpecker" takes over! What's next?

"Quickie" antennas for 18 MHz

It's fun to get on a new band and

experience a different set of operating conditions. When the 24-MHz band was opened for general Amateur use, I found this band's propagation modes quite different from those on either the 21 or 28-MHz bands. As more Amateurs gain experience on 18 MHz, they'll find the propagation different from that on 14 or 21 MHz. I have monitored 18 MHz for years and have run transmissions using an experimental license (KM2XDW). Propagation experiments with the Cocos-Keeling Islands and India show that 18 MHz will quickly earn a reputation as a first class DX band!

FIGURE 1



Delta loop for 18 MHz. Coax transformer is 9 feet long, plug tip to plug tip. It's wound into a coil about 6 inches in diameter.

You can't do much on any band without an antenna. Here are several "quickie" antennas specifically for 18 MHz that are easy to build and put into service. They're designed to be hung from a yardarm on an existing tower. Because these antennas have their own feedlines, you don't need to disturb anything in the primary antenna system. The tower doesn't affect their operation, and the wire antennas don't interact with the antenna atop the tower.

The 18-MHz delta loop

The delta loop in **fig. 1** is a good "first" antenna for 18 MHz. It has a slight gain over a dipole and is very "user friendly." The feedpoint impedance of the loop is about 120 ohms. Use a 75-ohm quarter-wave transformer to provide a reasonable match to a 50-ohm coax line. The transformer is wound into a coil to choke off RF currents that might flow on the outside of the coax shield.

The feedpoint of the loop terminates in an SO-239 coax connector mounted on a small insulator plate. The transformer has PL-259 plugs on both ends. Make the splice between the transformer and the 50-ohm line with a PL-258 splice adapter. After making the connection, weatherproof the plugs and adapter with coax tape or heat-shrink tubing.

The loop is supported at the apex and the side insulators are tied off to objects nearby. The radiation pattern is similar to that of a dipole and is horizontally polarized.

A multiband version of the delta loop

You can operate the delta loop on the 18, 21, 24, and 28-MHz bands if



America's Communications Leader Presents Its All-New 10-Meter SSB/CW Mobile Transceiver

Realistic, America's premier brand of scanners, CB radios and satellite TV systems introduces the HTX-100, the perfect first rig for a beginning Ham and a superb 10-meter mobile radio for any amateur. It's compact, yet loaded with "big rig" features.

Pushbutton Memory Tuning

An easy-to-program memory stores 10 favorite frequencies and



Ultracompact and includes everything you need for underdash installation

mike-mounted pushbuttons permit safe and easy up/down frequency selection while you drive. A front-panel lock control prevents accidental frequency changes. You can fine-tune reception with the ± 1.5 kHz RIT control. Coverage is 28.0 to 29.6999 MHz, USB or CW. Convenient semi break-in keying and CW sidetone are built in.

Selectable Power Output

You can select 25-watt or 5-watt QRP power output from the front panel. The HTX-100 has a backlit LCD frequency display with mode and tuning-step indicators. You also get a 5-step LED signal/RF power meter, noise blanker, hefty 3-watt audio output, high-quality built-in

speaker, front-panel headphone jack and a rear-panel jack for adding an external speaker.

Join the Action on "10"

With improving band conditions and new Novice voice and digital privileges, the 10-meter fun is just beginning. Be a part of it with this affordable, top-quality transceiver! Only \$259.95 and in stock today at our store near you.

Exclusively at

Radio Shack
The Technology Store™

A DIVISION OF TANDY CORPORATION

Price applies at participating Radio Shack stores and dealers

FREE 184-Page Radio Shack Catalog! Write Dept. 379, 300 One Tandy Center, Fort Worth, TX 76102

ALL ELECTRONICS CORP.

10 AMP SOLID STATE RELAYS

ELECTROL# S2181
CONTROL:

Rated 5.5 to 10 Vdc
(will operate on 3-32 Vdc).
LOAD: 10 amp @ 240 Vac
2 1/4" X 1 3/4" X 7/8"



CAT# SSR1Y-10B \$9.50 each
QUANTITY DISCOUNT

10 for \$85.00 • 25 for \$175.00
50 for \$300.00 • 100 for \$500.00

STROBE KIT



Variable rate strobe kit, flashes between 60 to 120 times per minute. Will operate on either 6 or 12 Vdc depending upon how you wire the circuit.

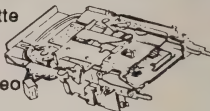
Comes complete with P.C. board and instructions for easy assembly.

CAT# STROBE-1 \$7.50 each

CASSETTE MECHANISM

Alpine cassette transport mechanism.

Includes stereo tape head, Mitsubishi # MET-3RF2B 13.2 Vdc motor, belt, pulleys, capstan, fast-forward, rewind and eject actuator. Does not include amplifier section. 6 1/2" X 5 1/4" X 1 3/4".



CAT# CMEC-5 \$7.50 each
10 for \$65.00

PIEZO WARNING DEVICE



Murata Erie # PKB8-4AD
High pitched audible alarm. Operates on 3 - 20 Vdc @ 20 ma. 1" high x 7/8" dia. P.C. board mount.
CAT# PBZ-84 \$1.75 each

XENON TUBE



1" long flashtube with 3 1/2" red and black leads. Ideal for electronic flash or strobe projects.
CAT# FLT-3 2 for \$1.00

NICKEL-CAD BATTERIES (RECHARGEABLE)

SPECIAL!! AAA SIZE

Panasonic # P-18AAA
1.2 volt @ 180 MAh
CAT# NCB-AAA \$1.50 each
10 for \$13.50 • 100 for \$125.00



AA SIZE \$2.00 each
1.25 volts 500 MAh
CAT# NCB-AA

AA SIZE \$2.20 each
WITH SOLDER TABS
CAT# NCB-SAA

C SIZE \$4.25 EACH
1.2 volts 1200 MAh
CAT# NCB-C

D SIZE \$4.50 each
1.2 volts 1200 MAh
CAT# NCB-D

TRANSISTORS

CAT#	TYPE	CASE	PRICE
PN2222	NPN	TO-92	5 for 75¢
2N2904	PNP	TO-5	3 for 1.00
2N2906	PNP	TO-18	3 for 1.00
PN2907	PNP	TO-92	5 for 75¢
2N3055	NPN	TO-3	\$1.00 each
PN3569	NPN	TO-92	5 for 50¢
2N3904	NPN	TO-92	5 for 75¢
2N3906	PNP	TO-92	5 for 75¢
2N4400	NPN	TO-92	5 for 75¢
2N4402	PNP	TO-92	5 for 75¢
2N5400	PNP	TO-92	4 for \$1.00
2N5880	NPN	TO-3	\$2.00 each
2N5882	NPN	TO-3	\$2.00 each
MJ2955	NPN	TO-3	\$1.50 each
MJE2955T	PNP	TO-220	75¢ each
MJE3055T	NPN	TO-220	75¢ each
TIP30	PNP	TO-220	75¢ each
TIP31	NPN	TO-220	75¢ each
TIP32	PNP	TO-220	75¢ each
TIP41	NPN	TO-220	75¢ each
TIP42	PNP	TO-220	75¢ each
TIP121	NPN	TO-220	75¢ each
TIP126	PNP	TO-220	75¢ each

WIDE BAND AMPLIFIER

NEC# UPC1651G. 1200 MHz @ 3 db.
Gain: 19db @ 1-500 Hz. 5 volt operation.
Small package 4mm dia. X 2.5 mm thick.
CAT# UPC-1651 2 for \$1.00
10 for \$4.50 • 100 for \$35.00

N-CHANNEL MOSFET

IRF-511 TO-220 case

CAT# IRF 511

\$1.00 each • 10 for \$9.00

LARGE QUANTITY AVAILABLE

OPTO SENSOR

U shaped package with mounting ears. 1/8" opening. 3/4" mounting holes. CAT# OSU-6 50¢ each
10 for \$4.50 • 100 for \$40.00



WALL TRANSFORMERS



ALL PLUG DIRECTLY INTO 120 VAC OUTLET

6 Vdc @ 200 ma. CAT# DCTX-620 \$2.25
6 Vdc @ 750 ma. CAT# DCTX-675 \$3.50
9 Vdc @ 250 ma. CAT# DCTX-925 \$2.50
12 Vac @ 930 ma. CAT# ACTX-1293 \$3.50
18 Vac @ 1 amp. CAT# ACTX-1885 \$3.50

SWITCHES

ITT PUSH BUTTON

ITT MDPL series. 3/4" X 1/2" gray rectangular key cap. S.P.S.T. N.O.

Push to close. RATED: 0.1 amp switching, 0.25 amp carry current. P.C. mount. CAT# PB-8 65¢ each • 10 for \$6.00 • 100 for \$50.00

10 POSITION MINI-ROTARY

Grayhill# 56P36-01-1-10N-C

Mini rotary switch. Non-shorting.

1 deck, 10 positions. .125" dia.

shaft X .375" long. .377" behind the panel depth. P.C. pins.

CAT# MRS-10 \$2.50 each

HALL EFFECT SWITCH

MICROSWITCH# 4BE3

Slanted keyboard switch with hall effect sensor. Snaps into 5/8" square chassis hole. Hall effect sensor slides easily from switch and can be used in other applications.

CAT# HESW 4 for \$1.00

10 for \$2.00 • 100 for \$15.00

SPDT PUSHBUTTON

Marquard# 1843

Rated 6 amps @ 125/250 Vac.

Black plastic pushbutton.

Switch body: .92" X .94" X .65".

CAT# PB-18 \$1.65 each • 10 for \$15.00 each



LED'S

STANDARD JUMBO

DIFFUSED T 1-3/4 size

RED CAT# LED-1

10 for \$1.50 • 100 for \$13.00

GREEN CAT# LED-2

10 for \$2.00 • 100 for \$17.00

YELLOW CAT# LED-3

10 for \$2.00 • 100 for \$17.00

FLASHING LED

with built in flashing circuit operates on 5 volts...

RED CAT# LED-4 10 for \$9.50

GREEN CAT# LED-5 10 for \$9.50

CAT# LED-6 10 for \$9.50

BI-POLAR LED

Lights RED one direction, GREEN the other. Two leads.

CAT# LED-8 2 for \$1.70

LED HOLDER

Two piece holder.

CAT# HLED 10 for 65¢

RELAYS

12 VOLT D.C. COIL S.P.D.T.

Omnron# G2E-184P

4 Amp contacts

335 ohm coil

Sugar cube size.

.61" X .42" X .44" high.

P.C. mount with pins on DIP spacing.

CAT# RLY-787 \$1.50 each

120 VOLT A.C. - D.P.D.T.

GUARDIAN# 1220U-04

10 Amp contacts.

1,100 ohm coil

1.703" X 1.578" X 1.687".

Clear

polycarbonate cover. Gold plated solder or socket mount terminals.

CAT# RLY-228 \$3.50 each



CALL OR WRITE FOR OUR FREE CATALOG OVER 4000 PARTS!



MAIL ORDERS TO:
ALL ELECTRONICS
P.O. BOX 567
VAN NUYS, CA 91408

TWX-5101010163 (ALL ELECTRONIC)

OUTSIDE THE U.S.A.
SEND \$2.00 POSTAGE FOR A CATALOG!!

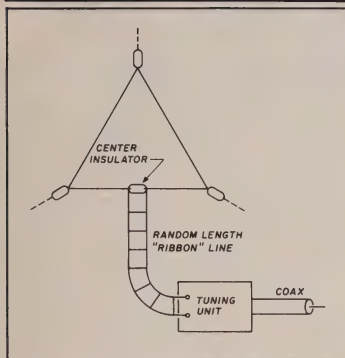
ORDER TOLL FREE
800-826-5432

INFO: (818)904-0524

FAX: (818)781-2653
MINIMUM ORDER \$10.00
QUANTITIES LIMITED
CALIF. ADD SALES TAX
USA: \$3.00 SHIPPING
FOREIGN ORDERS
INCLUDE SUFFICIENT
SHIPPING. NO C.O.D.



FIGURE 2



Balanced line feed with antenna tuning unit at station permits multiband operation of delta loop shown in fig. 1.

you feed it with a two-wire balanced line as shown in fig. 2. Transmitting-type 300-ohm ribbon line is satisfactory. You can also use open-wire style line. Match the line to a coax feed system by way of an antenna tuner (ATU or Transmatch) located at the station.

If you have difficulty loading the antenna on a band, change the length of the line between the antenna and the ATU. There is a standing wave on the line, and a particular line length may present an unacceptable load to the tuning unit. To solve this problem, add a few feet of line (a foot at a time) until you get a satisfactory match.

The bi-square array for 18 MHz

The diamond-shaped bi-square beam is much larger than the delta loop, but provides about 3-dB gain. This is a great antenna to try if you have the space. It's shown in fig. 3.

The loop is a half wavelength on a side and open at the top. The feedpoint impedance at the bottom of the loop is about 2900 ohms; I use a two-wire 600-ohm quarter-wave stub to provide a more reasonable impedance value of about 122 ohms. Match it to a 50-ohm coax line by adding a quarter-wave transformer made of 75-ohm coax. Wind the 75-ohm line into a coil about 6 inches in diameter to reduce RF currents flowing on the out-

side of the coax. Under these conditions, the SWR on the transmission line is less than 1.2:1 across the band once the antenna is adjusted for resonance.

Tuning the antenna

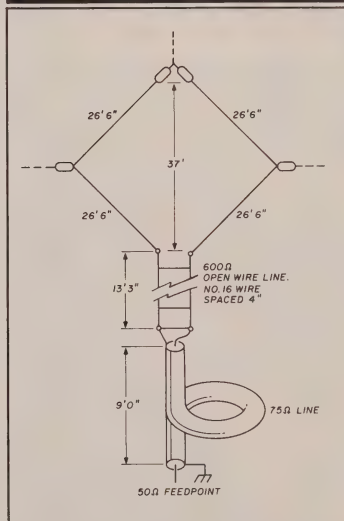
Resonate the loop and stub to 18.1 MHz with a dip meter. Temporarily close the stub at the bottom using a movable short with a 1-turn loop in the middle. I made mine with two copper alligator clips so I could move it up and down the stub a few inches. I adjusted the position of the short until I achieved antenna resonance with the dip meter, as monitored in a nearby receiver. As soon as you find the resonance, remove the short and place an SO-239 coax receptacle across the bottom of the line.

You'll need to waterproof the coax receptacle and all plugs and splices in the system. It's imperative to use coax tape or other weatherproofing compounds to keep water out of the line.

An extended dipole for 18 and 28 MHz

The extended dipole in fig. 4 will

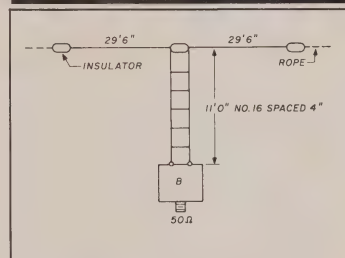
FIGURE 3



"Bi-square" beam provides a bi-directional pattern and about 3-dB gain over a dipole. Note that top of loop is open.

work on the 18 and 28-MHz Amateur bands. I discussed the theory behind this antenna in my April, 1987 *Ham Radio* column. The antenna consists of two extended half waves in phase on 18 MHz, fed by an open-wire matching stub. The total wire length of antenna and stub on 10 meters is about 2-1/2 wavelengths. You can achieve a good resonance on both bands. The feedpoint impedance is close to 50 ohms.

FIGURE 4



Dual-band dipole is fed with open-wire section and 1:1 balun (B). Antenna may be mounted in inverted-V configuration.

The antenna presents a typical dipole radiation pattern on 18 MHz; on 28 MHz the pattern has a cloverleaf shape.

Use a 1:1 balun at the feedpoint or coil the coax line into a 5-turn RF choke, as described for the previous antenna.

A trap dipole for the 18 and 24-MHz bands

This simple trap antenna covers the 18 and 24 MHz bands and makes an ideal companion to a tribander beam. The two antennas cover all bands between 20 and 10 meters at the flick of a coax switch.

A practical design is shown in fig. 5. The trap is designed around a 25-pF 5-kV ceramic capacitor. You can find some of the older Centralab-type 850 capacitors at flea markets. High Energy Corporation, Lower Valley Road, Parkesburgh, Pennsylvania 19365, manufactures new capacitors. The coil is made of Barker and William-son coil stock. The coil-capacitor com-

GORDON WEST'S RADIO SCHOOL

21 DAY NOVICE



- 2 code tapes
- 112 page book
- World maps
- Frequency charts
- Course certificate
- Free magazine coupon
- 50 piece literature set!

\$70 in equipment certificates from ICOM, KENWOOD, and YAESU **\$19.95**

COMPLETE NOVICE COURSE **\$49.95**

- 4 code tapes, 2 theory tapes, 2 text books, code oscillator set, examiner test packet, and \$70 discount coupons.

NOVICE TEXTBOOK **\$4.95**

- Written by Gordon West, this 112 page book contains all Novice questions and answers.

NOVICE CODE COURSE **\$39.95**

- 6 tape stereo code course for learning the code from scratch. Includes certificates.

TECHNICIAN THEORY COURSE **\$19.95**

- 2 theory tapes & 2 textbooks.

GENERAL THEORY COURSE **\$19.95**

- 2 theory tapes & 2 textbooks.

TECHNICIAN/GENERAL COURSE **\$19.95**

- Combined tech & general course with 4 tapes and 1 book.

THE COMPLETE GENERAL **\$49.95**

- 4 tapes & 2 books for theory plus 6 tape stereo code set for CW speed building.

GENERAL CODE COURSE **\$39.95**

- 6 tape stereo code course for CW speed building from 5 wpm to 13 wpm.

THE COMPLETE ADVANCED **\$49.95**

- 4 tapes & 2 books for theory plus 6 tape stereo general or extra class code course. (Specify which CW tapes you want.)

ADVANCED THEORY CLASS **\$19.95**

- 4 tape stereo theory course plus fully illustrated theory book.

THE COMPLETE EXTRA **\$49.95**

- 4 tapes & 2 books for theory plus 6 tape stereo code set for CW speed building 13 wpm to 22 wpm.

EXTRA CODE COURSE **\$39.95**

- 6 tape stereo code course for CW speed building from 13 wpm to 22 wpm.

EXTRA THEORY CLASS **\$19.95**

- 4 tape stereo theory plus fully illustrated theory book.

GORDON WEST ELECTRONICS BOOK

- 200 page marine electronics book plus marine mobile antenna hints. **\$19.95**

COMMERCIAL TEST PREP BOOK **\$29.95**

BASS CODE KEY & OSCILLATOR **\$19.95**

PLASTIC CODE KEY & OSCILLATOR **\$14.95**

COPPER GROUND FOIL **60¢ FOOT**

SINGLE CODE TAPES

\$9.95 EACH • BUY 2, GET 3rd ONE FREE

- 5 wpm Novice Tests • 5 wpm Random Code
- 5-7 Speed Build • 7-10 Speed Build • 10 Hump Jump
- 10-12 Speed Build • 12-15 Calls & Numbers
- 13 Random • 13 Test Prep • 5-15 General Quiz
- 13 Car Code • 13-15 Speed Build • 15-17 Speed Build
- 17-19 Speed Build • 20 Random • 20 Test Prep
- 20 Car Code • 10-24 Extra Quiz

Pass any upgrade & receive \$25 Menwood rebate
** plus a license holder & wall certificate FREE! **

Slow code uses 13 wpm character speed. Some day service. Add \$3.00 UPS for courses, or \$1.00 for single tapes. 100% return policy.

GORDON WEST RADIO SCHOOL

2414 COLLEGE DR., COSTA MESA, CA 92626

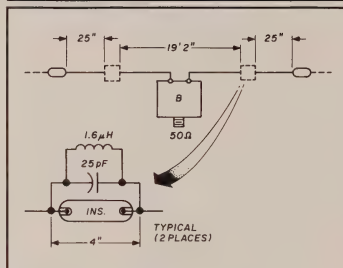
Mon.-Fri. 10-4pm (714) 549-5000

bination is mounted to a short ceramic insulator, as shown in the illustration.

Before placing the traps in the antenna, check their frequency with a dip meter and a calibrated receiver. The design frequency is 24.95 MHz. Place the trap in an area free of metallic objects and couple it loosely to the dip meter. Note the resonant frequency; it should be within ± 100 kHz, of the design frequency.

One end turn of each trap can be broken free of the coil bars, and moved about or trimmed to set the exact point of resonance. Do this after attaching the trap to the insulator — the capaci-

FIGURE 5



Trap antenna for 18/24 MHz. Trap is mounted across ceramic insulator. Coil consists of 12-3/4 turns, no. 20, 5/8-inch diameter, 16 turns/inch. (Barker and Williamson 3007.)

tance across the insulator influences the resonant frequency of the trap to a degree.

You can trim the end sections "on the nose" by erecting the antenna in the clear about 6 feet above the ground. Place a half-turn coil across the center insulator of the antenna and check the 18 and 24-MHz resonances with a dip oscillator. Removing 1 inch on each side of the center sections moves the resonant frequency 100 kHz at 24.9 MHz. You must adjust the inner sections before resonating the tip sections. I cut my tip sections about a foot long and twisted the extra length back on the antenna. I took off the extra length upon reaching the right resonant point at 18.1 MHz. The SWR across either band will be less than 1.5:1 when the antenna is in place.

A really simple shortwave receiver

Are you tired of modern high-tech radios? Do you yearn for the good old days when radios had only a couple of knobs? Well, fig. 6 shows the receiver for you. The radio uses only three tubes and runs on inexpensive A, B, and C batteries. I've included a layout of the aluminum chassis to help you build this little set. You say your local ham store doesn't carry plug-in coils, radio tubes, tube sockets, tuning capacitors, etc? Well, what does it carry?...Oh!

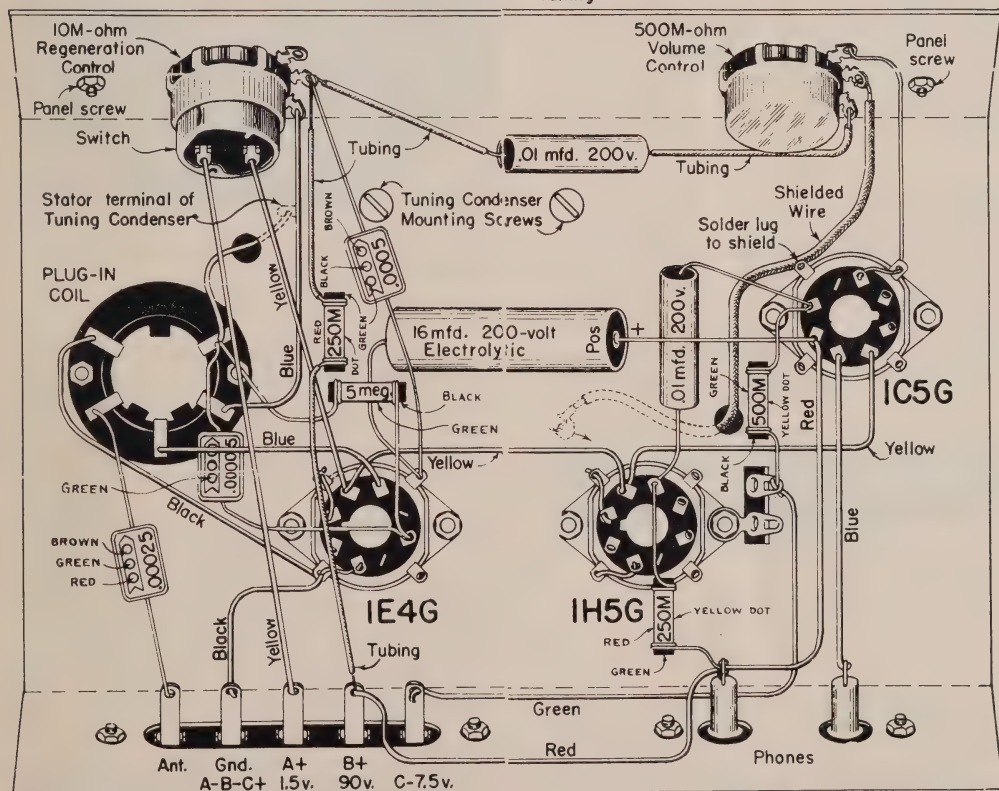
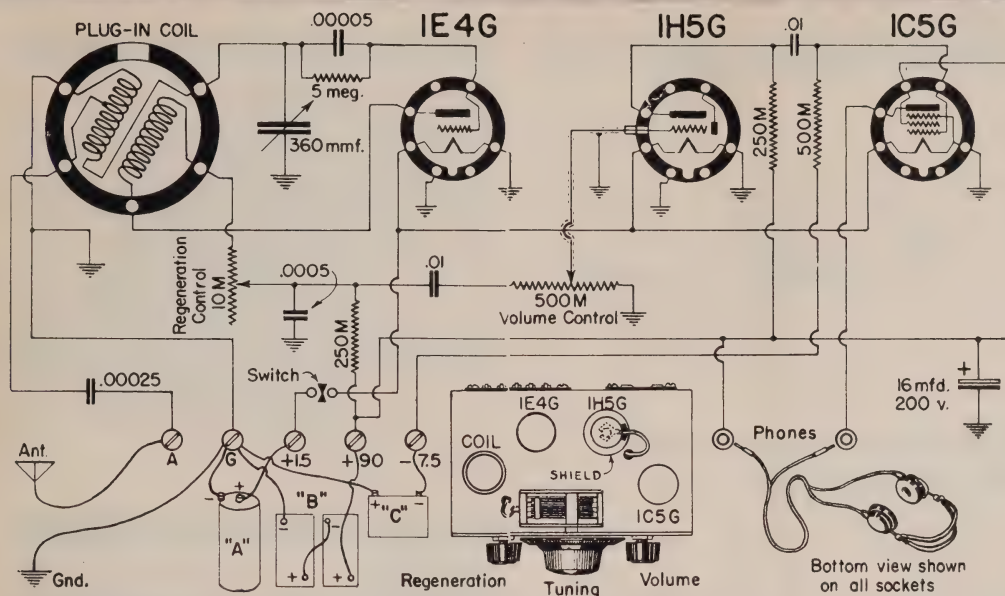
The W6SAI "Dead Band" contest

I salute my readers who spotted the quotation from *Catcher in the Rye*, by J. D. Salinger. The remark was made by the anti-hero, Holden Caulfield. Kudos to the following with a special salute (*) to those who really know their rye:

Tony Emanuele, WA8RJF; Lou Axeman, N8LA (*); Bill Wootton, WO7J; Steve Buol, KB0BDS; David Raskin, W5TYL; Jim Fox, N7ENI; Jack Starin, WF8M; Bob Esquire, W9UI/8; Larry Walsh, W5SMA; Martha Wilder, N3FZB; Phil Brandt, W3ELJ; Bruce Rossi, NF7J; Jim Lignugaris, N2IDV; Dick Olson, NS0W; Marty Johnson, W3YOZ (*); Marty Davidoff, K2UBC (*); Preston Douglas, WA2IFZ; Roger Leone, K6XQ; Serafino Conflitti, VE3LKN; Eric Nichols, KL7AJ; Bill Calderwood, K1CT; Roger Tobin, N1EYZ; and Frank Smith, W4EIN. Congratulations to all!

School is out and this is winter break. No quiz this month. Instead, I want to recommend a great book. It has nothing to do with Amateur Radio, but it's the best adventure story I've ever read. It covers territory from Vladivostok to Odessa in an exciting tale about two great men. *The Cowboy and the Cossack*, by Clair Huffaker was published by Trident Press, New York (1973). Unfortunately the book is out of print, but it's worth your time to check in a second-hand book store. This is a wonderful book to read when the band is dead!

FIGURE 6



Article B

Schematic of 3-tube regenerative receiver. Just the thing for the new Amateur!

HAM RADIO

THE WEEKENDER



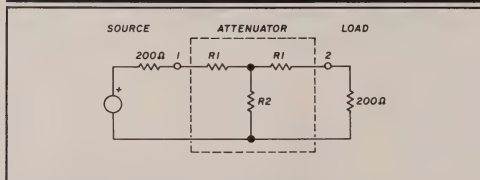
High-impedance rotary step attenuator

Need a step attenuator? I was building ladder crystal filters and wanted an attenuator to help in making the passband measurements. I only needed a few steps, and a rotary switch similar to one made by W9ERU¹ was more appealing to me than the laboratory type² with banks of slide switches. A 200-ohm impedance level is appropriate for the filters. But you can construct any impedance level by using resistors scaled to the values shown here.

Switch

You'll need a 3-deck rotary switch to select the proper resistors for the T-Network shown in **fig. 1**. My junkbox yielded a 7-position one. I selected attenuation values of 0, 3, 6, 12, 20, 30, and 40 dB as convenient values for my crystal filter work. You can duplicate these if your switch has 7 positions, or calculate the resistors for any other number of positions or dB values using the information at the end of this article. Tables of resistor values (50 ohms) also appear in recent editions of *The ARRL Handbook*.³

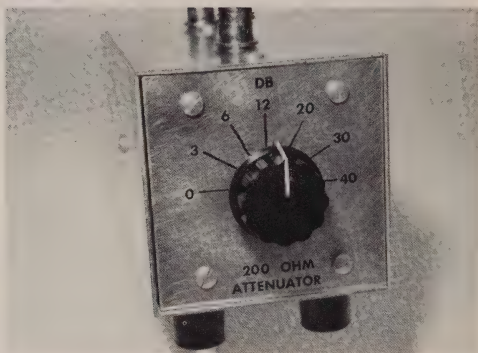
FIGURE 1



Schematic of the basic T-Network on which the step attenuator is based.

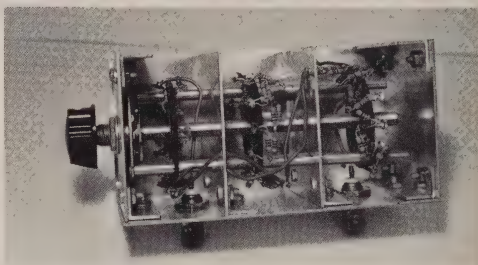
By John Pivnichny, N2DCH, 3824 Pembroke Lane, Vestal, New York 13850

PHOTO A



Front panel view of the step attenuator. Note attenuation values labeled on the front.

PHOTO B



Internal view of the step attenuator showing partitions used for additional RF shielding.

Enclosure

You can mount the switch in a 2-1/2" x 2-1/2" x 5" homebrew box. Sheet aluminum 0.05" thick, cut on a metal shear makes a neat box. I also included two shield partitions (also 2-1/2" x 2-1/2") to prevent stray coupling between switch decks. One-half inch aluminum angle stock, 1/16" thick, holds the sheet metal pieces together forming a rigid and rugged box. See **photos A and B** for details. Note that the bottom plate is exactly 2-1/2" x 5", but the top and sides are cut slightly wider (2-9/16" x 5") to provide proper overlap of the adjoining edges. I fastened four rubber feet to the bottom plate. As a finishing touch, I applied dry-transfer letters and India Ink to the front panel after buffing with emery paper. I used clear spray lacquer to protect the letters and keep them from rubbing off.

Resistors

The necessary resistance values for R1 and R2 in **fig. 1** are listed in **table 1**. The power rating is also important. For example, in the 3-dB position half of the input power

TABLE 1

Resistor values for R1 and R2.

dB	R1 (ohms)	R2 (ohms)
3	34	567
6	66.8	268
12	120	108
20	163.6	40.5
30	188	12.6
40	196	4

TABLE 2

Resistor values in fig. 2

	ohms	1/4-watt resistors (ohms)
Ra	34	68 P 68
Rb	34	15 S 18
Rc	53	100 P 110
Rd	43	22 S 22
Re	25	47 P 56
Rf	8	15 P 15
Rg	4	12 P 12 P 12
Rh	8.5	15 P 15
Ri	28	56 P 56
Rj	65	150 P 120
Rk	157	330 P 330
RI	300	150 S 150

S = series connection

P = parallel connection

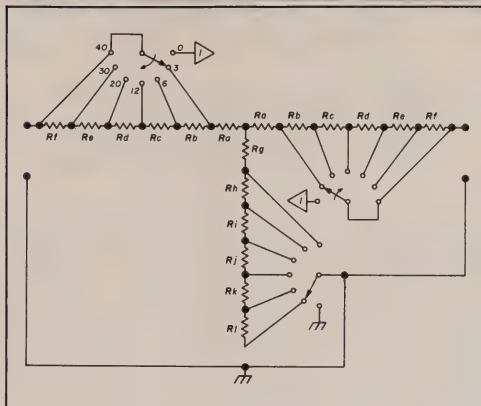
is delivered to the load and the other half must be dissipated by the resistors in the T-Network. At 6 dB, 75 percent of the power is dissipated in the T-Network; at 40 dB, only 0.01 percent goes to the load.

With power in mind, use a series connection of resistors so the power is shared. **Figure 2** shows the final schematic and **table 2** lists the series resistor values. These aren't standard values, so make a reasonable approximation to Amateur accuracy (± 2 percent or so) by selecting two nearly equal standard values and connecting them in parallel or series to obtain the values in **table 2**. (The 4-ohm value is made with 3 12-ohm resistors in parallel.)

I used 1/4-watt resistors as indicated in the last column of **table 2**. Each individual resistor of **fig. 2** can therefore dissipate 1/2 watt. A careful calculation of power shows that this attenuator handles up to a 20-volt RMS (56 volts p-p) input voltage, or 2 watts. At that level the 53-ohm resistor will dissipate almost 0.53 watt at 12 dB and greater positions. The remaining 1.5 watts is dissipated in the other resistors, all of which are safely below a half watt each.

Crystal filters can be damaged by excess voltage. I don't recommend putting 20 volts into one. This attenuator will easily handle the signal levels you normally encounter.

FIGURE 2



Schematic of the step attenuator using a 7-position 3-deck rotary switch.

Checkout

After completing the attenuator, make two tests to ensure that there are no wiring errors. First, attach a 200-ohm load to one of the connectors (I used two 390-ohm, 1-watt resistors in parallel). Measure the resistance at the other connector with your ohmmeter. It should read 200 ohms at all switch positions. Repeat this test with the connections reversed.

Second, apply a 20-volt DC potential at one connector with the load attached at the second connector. Read the voltage across the load at each switch position and compare it to **table 3**. As before, repeat this test with the connections reversed.

Conclusion

You now have a rotary step attenuator for crystal filter measurements. It's a handy accessory that takes only a weekend to build.

TABLE 3

Output voltage readings with 20 volts at the input

dB	volts
0	20
3	14.4
6	10
12	5
20	2
30	0.63
40	0.2

Appendix — resistor value calculation

Refer to **fig. 1**; the resistance looking into node 1 must be 200 ohms.

$$[(200 + R1) || R2] + R1 = 200$$

$$\frac{(200 + R1) R2}{200 + R1 + R2} + R1 = 200 \quad (1)$$

after some algebra:

$$R1^2 + 2R2R1 - 200^2 = 0$$

by the quadratic formula:

$$R1 = -R2 \pm \sqrt{R2^2 + 200^2} \quad (2)$$

reject the negative value and define:

$$P = \frac{(200 + R1) R2}{200 + R1 + R2}$$

then the attenuation is given by the voltage dividers:

$$\frac{V2}{V1} = \frac{200}{200 + R1} \cdot \frac{P}{R1 + P} \quad (3)$$

The procedure for calculating resistor values is as follows:

- Pick a value for R2.
- Compute R1 using eqn. 2.
- Compute P.
- Compute attenuation V2/V1 using eqn. 3.
- Compute dB from dB = $-20 \log_{10}(V2/V1)$.

You can write a short BASIC program with any small home computer to perform these calculations. A for-next loop with values of R2 from 1-400 ohms will generate R2 values to the nearest ohm. Use additional loops in 0.1-ohm steps to calculate more accurate values.

Note: Not all versions of BASIC have the base 10 logarithm function. To convert from the base e natural logarithm to base 10, multiply the base e result by 0.43429.

References

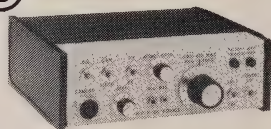
1. Eugene A. Hubbell, W9ERU, "A Step-Type R.F. Attenuator," *QST*, vol. 43, no. 12, December 1959, pages 20-22.
2. Bob Shriner, WA0UZO, and Paul K. Pagel, N1FB, "A Step Attenuator You Can Build," *QST*, vol. 66, no. 9, September 1982, pages 11-14.
3. *The ARRL Handbook*, Newington, Connecticut, 62nd edition, 1985, page 25-44.

Article C

HAM RADIO

AMATEUR TELEVISION

SMILE! YOU'RE ON TV



Only
\$299

Designed and
built in the USA
Value + Quality
from over 25 years
in ATV...W6ORG

With our all in one box TC70-1 70cm ATV Transceiver you can easily transmit and receive live action color and sound video just like broadcast TV. Use any home TV camera or VCR by plugging the composite video and audio into the front VHS 10 pin or rear phono jacks. Add 70cm antenna, coax, 13.8 Vdc and TV set and you are on the air...it's that easy!

TC70-1 has >1 watt p.e.p. with one xtal on 439.25, 434.0 or 426.25 MHz, runs on 12-14 Vdc @ .5A, and hot GaAsfet downconverter tunes whole 420-450 MHz band down to ch3. Shielded cabinet only 7x7x2.5". Transmitters sold only to licensed amateurs, for legal purposes, verified in the latest Callbook or with copy of license sent with order.

Call or write now for our complete ATV catalog including downconverters, transceivers, linear amps, and antennas for the 70, 33, & 23cm bands.

(818) 447-4565 m-f 8am-5:30pm pst.

Visa, MC, COD

P.C. ELECTRONICS

2522 Paxson Ln Arcadia CA 91006

Tom (W6ORG)

Maryann (WB6YSS)

COMPUTERIZE YOUR SHACK

YAESU 747, 757GX, 757GXII, 767, 9600.
KENWOOD TS 140, 440, 940, 680, R5000.
ICOM R71A, R7000, 735, 751A, 761, 781, AND ALL VHF, UHF, CI-V.
DRIVERS FOR RADIOS ARE MODULAR.
JRC NRD 525.

COMPLETE PROGRAM ENVIRONMENT.
MENU DRIVEN AND DESIGNED FOR EASE OF USE.
SCAN FUNCTION ADDED TO RADIOS THAT DO NOT SUPPORT IT.
ERGONOMETRICALLY DESIGNED FOR EASE OF OPERATION.
MOST FUNCTIONS REQUIRE SINGLE KEYSTROKES.
PROGRAM COLOR CODED FOR EASE OF USE, ALTHOUGH WILL STILL
RUN IN A MONOCHROME SYSTEM.

MENUS FOR THE FOLLOWING:

AMATEUR HF—AMATEUR VHF— AMATEUR UHF
AM BROADCAST—FM BROADCAST—TELEVISION BROADCAST
SHORT WAVE BROADCAST
AVIATION HF(SSB)—AVIATION VHF—AVIATION UHF
HIGH SEAS MARINE—VHF MARINE
MISCELLANEOUS HF, VHF, UHF
MOST POPULAR FREQUENCIES ALREADY STORED
ADDITIONAL LIBRARIES AVAILABLE
COMPLETE LOGGING FACILITY
ALL FREQUENCY FILES MAY BE ADDED TO, EDITED OR DELETED

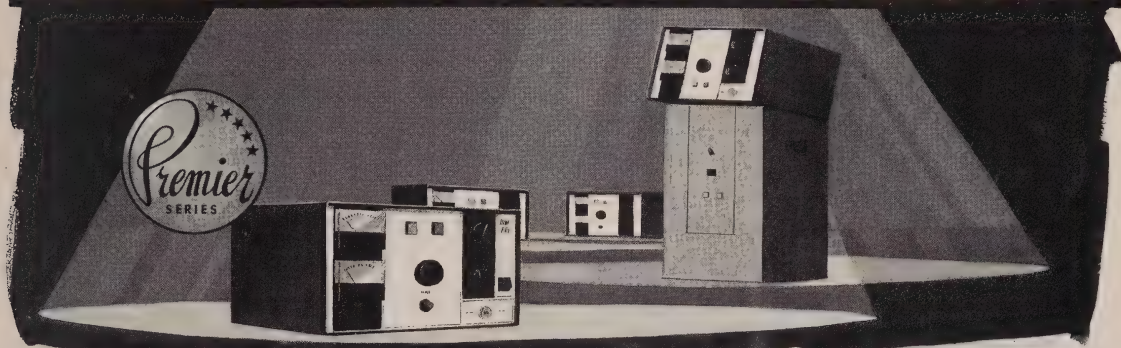
AVAILABLE FOR IBM PC, XT, AT, 80386 256K RAM
1 SERIAL PORT AND 1 FLOPPY MINIMUM

PROGRAM WITH INITIAL LIBRARIES	99.95
RS-232 TO TTL INTERFACE ONLY (NEEDED IF DON'T HAVE MANUFACTURERS INTERFACE)	
EXTERNAL INTERFACE ALLOWS 4 RADIOS	99.95
INTERNAL PC INTERFACE W/1 SERIAL & 1 RADIO PORT	129.95
SPECTRUM ANALYZER MODULE	(CALL FOR PRICE)
COMPLETE SYSTEMS INCL. RADIO, INTERFACE, COMPUTER, AVAILABLE	(CALL FOR PRICE)

DATA COM, INT.

8081 W. 21ST LANE
HIALEAH, FL 33016
AREA CODE (305) 822-6028

..... EXCITING NEW FEATURES. . .
 PROVEN VALUE. . . GUARANTEED RELIABILITY
PREMIER SERIES



HENRY RADIO'S NEW PREMIER SERIES . . . AMPLIFIERS FOR THE DISCRIMINATING AMATEUR WHO REFUSES TO COMPROMISE . . . THE 3K PREMIER AND 3KD PREMIER DELUXE AMPLIFIERS. ALL OF THE MATCHLESS QUALITY AND FEATURES OF THEIR PREDECESSORS PLUS QSK BREAK-IN KEY AND 160 METER BAND.

THE PREMIER SERIES

- ☆ **The 3K Premier Console** --- all the rugged reliability of the 3K Console plus QSK and the 160 meter band.
- ☆ **The 3KD Premier Desk Model** --- the same RF deck in a smaller and lighter configuration.
- ☆ **The 3002-A Console** --- maximum legal power in a two meter block buster.
- ☆ **The 3004-A Console** --- a unique new approach to high power UHF amplification at 440 MHz.

Attention: All HF amplifiers can be modified for 10 meters • All export HF amplifiers are shipped with 10 meter operation included • Please call or write for a complete information packet

FCC type acceptance pending on 3K Premier and 3KD Premier models.

Henry amateur amplifiers are available from select dealers throughout the U.S. and are being exported to amateurs all over the world. Henry Radio also offers a broad line of commercial FCC type accepted amplifiers for two way FM communications to 500 MHz, as well as special RF power generators for industrial and scientific users. Call or write Ted Shannon for full information.

We stock these plus many other line names:
 AEA • ARCO • ARRL • ASTRON • B & K • B & W • BIRD • CDE • CONNECT-SYSTEMS • CUSHCRAFT • EIMAC • HAL • HUSTLER • HY-GAIN • ICOM • KENWOOD • LARSEN • NYE • TEMPO • VIBROPLEX • YAESU

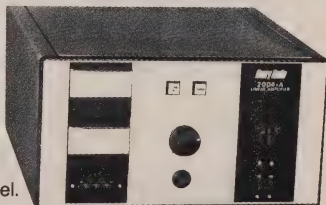
THE CLASSIC LINE

(Still available as before)

- 2KD Classic Desk Model** --- 3.5 - 21.5 MHz. (Two 3-500-Z tubes---the design Henry made famous)
- 2K Classic Console** --- the original and still the standard workhorse.
- 2K Classic "X" Console** --- made heavy duty, rugged and reliable for a lifetime of service.
- 3K Classic Console** with the magnificent 3CX1200A7 final tube.

2002-A...a two-meter desk model using the Eimac 3CX800A7... because this tube is rated at a 15dB gain, only about 25 watts drive is required for full output.

2004-A UHF desk model.



Henry Radio

2050 S. BUNDY DR. LOS ANGELES, CA 90025 (213) 820-1234
 Toll free order number: (800) 877-7979 TELEX: 67-3625(Henradio) FAX (213) 826-7790



INSIDE VIEW — RS-12A

ASTRON POWER SUPPLIES

• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output
- CROWBAR OVER VOLTAGE PROTECTION on all Models except RS-3A, RS-4A, RS-5A.
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS

- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC \pm 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- Also available with 220 VAC input voltage



MODEL RS-50A

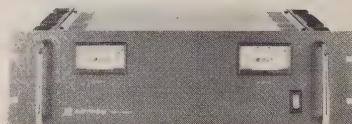


MODEL RS-50M



MODEL VS-50M

RM SERIES



MODEL RM-35M

19" x 5 1/4" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
RM-12A	9	12	5 1/4 x 19 x 8 1/4	16
RM-35A	25	35	5 1/4 x 19 x 12 1/2	38
RM-50A	37	50	5 1/4 x 19 x 12 1/2	50

- Separate Volt and Amp Meters

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
RM-12M	9	12	5 1/4 x 19 x 8 1/4	16
RM-35M	25	35	5 1/4 x 19 x 12 1/2	38
RM-50M	37	50	5 1/4 x 19 x 12 1/2	50

RS-A SERIES



MODEL RS-7A

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
RS-3A	2.5	3	3 x 4 1/4 x 5 1/4	4
RS-4A	3	4	3 3/4 x 6 1/2 x 9	5
RS-5A	4	5	3 1/2 x 6 1/4 x 7 1/4	7
RS-7A	5	7	3 3/4 x 6 1/2 x 9	9
RS-7B	5	7	4 x 7 1/2 x 10 1/4	10
RS-10A	7.5	10	4 x 7 1/2 x 10 1/4	11
RS-12A	9	12	4 1/2 x 8 x 9	13
RS-12B	9	12	4 x 7 1/2 x 10 1/4	13
RS-20A	16	20	5 x 9 x 10 1/2	18
RS-35A	25	35	5 x 11 x 11	27
RS-50A	37	50	6 x 13 1/4 x 11	46

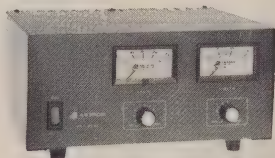
RS-M SERIES



MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter RS-12M	9	12	4 1/2 x 8 x 9	13
• Separate volt and Amp meters RS-20M	16	20	5 x 9 x 10 1/2	18
RS-35M	25	35	5 x 11 x 11	27
RS-50M	37	50	6 x 13 1/4 x 11	46

VS-M AND VRM-M SERIES



MODEL VS-35M

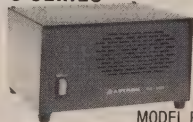
- Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC @10VDC @5VDC	ICS* (Amps) @13.8V	Size (IN) H x W x D	Shipping Wt. (lbs.)
VS-12M	9	12	4 1/2 x 8 x 9	13
VS-20M	16	20	5 x 9 x 10 1/2	20
VS-35M	25	35	5 x 11 x 11	29
VS-50M	37	50	6 x 13 1/4 x 11	46

- Variable rack mount power supplies

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
VRM-35M	25	35	5 1/4 x 19 x 12 1/2	38
VRM-50M	37	50	5 1/4 x 19 x 12 1/2	50

RS-S SERIES



MODEL RS-12S

- Built in speaker

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
RS-7S	5	7	4 x 7 1/2 x 10 1/4	10
RS-10S	7.5	10	4 x 7 1/2 x 10 1/4	12
RS-12S	9	12	4 1/2 x 8 x 9	13
RS-20S	16	20	5 x 9 x 10 1/2	18

THE L-MATCH

A useful tool for improving your SWR

By Robert C. Cheek, W3VT, 29 Center Drive, Briarcliffe Acres, Myrtle Beach, South Carolina 29572

How often have you carefully calculated the length of a dipole antenna, cut it to just the right length, used coax cable which should have given you a reasonably good match, and then found that the SWR just wouldn't go below 2:1? And how often did the SWR rise to an unacceptably high level in the phone portion of the band even though you had an acceptable match in the CW portion (or vice versa), especially on the 3.5 and 7-MHz bands? If your experience has been anything like mine, the answer is: "Almost always!" If you like to operate both phone and CW, the same experience probably applies to your Yagis on the higher frequency bands. You may have a good SWR in one segment of a band, but elsewhere it rises to a point where a modern transistorized rig automatically starts cutting down on power output.

Many modern transceivers have built-in automatic antenna tuners, and I suspect that's why we hear more on-the-air tuning these days. They are a lazy man's solution to poor SWR. Unfortunately, those already in contact with someone on the chosen tuning frequencies must continually pay for this practice.

Power amplifiers usually don't have built-in tuners. Even if you tune your amplifier into a dummy load first, you must touch up the tuning with your antenna connected if the SWR is more than about 1.3:1 (another excuse for on-the-air tuning). Wouldn't it be much better to have an SWR close to 1:1 in both the phone and CW segments of the band so all your tuning could be done with a dummy load? Then you could switch your rig to the antenna without further tuning and unnecessary QRM.

A universal antenna tuner with predetermined and carefully marked settings could solve these problems, if you had the patience to reset it each time you made a substantial frequency change. But a simpler, more compact, and less expensive answer to these and many other impedance-matching problems is a well-known, old-fashioned, but infrequently used technique — the L-

match. This application of the L-match is mentioned very briefly in the *ARRL Antenna Book*.

I use several fixed L-match configurations; all are built into miniboxes (although I sometimes run 1500 watts PEP). One of these is permanently inserted at the input end of several different coax cables, each feeding a different antenna. Some have a switch to by-pass the network for operation on a frequency range over which the SWR is acceptably close to 1:1. The switches are within reach of my operating position.

This article shows derivations of formulas for calculating the reactances, and corresponding capacitance and inductance values, needed in an L-network to make a mismatched line appear to have 1:1 SWR. This makes it look like a desired pure resistance (normally you'll want 50 ohms) to the transmitter at a specified frequency. I've included a program in GW-BASIC for IBM PC compatible computers, but you can also use the formulas and a calculator with a square-root function to make the necessary calculations. The program selects all the possible capacitance and inductance configurations that provide a match for a given case and does the necessary calculations for each configuration. (There may be as many as four different combinations that will do the job for one set of conditions.) The program checks its own results by calculating independently the input impedance of the line with the matching network added, and comparing it to the desired input resistance. I've described a few actual networks to show the design procedure, some possible construction approaches, and the "before" and "after" results.

Some application notes

The L-match is more versatile than is generally recognized and understood. Theoretically an L-type network consisting of only two elements (a shunt element and a series element) can match any two complex impedances to each other at a given frequency, as long as the elements are perfectly lossless. Of course you can't have

either inductors or capacitors of infinite "Q", and for applications involving very large impedance transformations there are some limitations. But in the application discussed here, the impedances to be matched aren't different enough to present a problem.

There are other limitations that should be considered in this application. One limitation is that although an antenna tuner (or any other matching device at the transmitting end of a coax line) may make the transmitter see a 1:1 SWR, it doesn't in any way affect the SWR in the line beyond the device. Losses in a mismatched line are higher than if the impedance were matched at the antenna end. Fortunately, this effect isn't serious if you use good quality cable in good condition — unless you have lines several hundred feet long at the higher frequencies (28 MHz or higher).

As SWR departs from the ideal 1:1, the voltage and the current at some points on the line become greater than those that exist uniformly on a matched line at the same level of power transfer. For example, at an SWR of 4:1 the voltage and current at some places along the line will be twice what they would be if the line were matched at the antenna end with the same power going into the antenna. Pay attention to the voltage rating and the current-carrying capacity of the line. The 5000 volt rating of the RG-213 cable gives plenty of margin for poor SWR, compared with the 275 volts present at 1500 watts when the line is matched. A cable connection is far more likely to break than the cable itself if the voltage is excessive at a connection point. The current rating (imposed by the possibility of cable damage due to internal heating) is a more important limitation. The same cable is rated at 3500 watts at 10 MHz, or about 8.4 A when the SWR is 1:1. With a 4:1 SWR, the current will reach about 11 A at 1500 watts. In our intermittent types of service, peak currents of this level at widely separated points on the line should cause no damage. But there's probably some cause for concern somewhere not too far above 4:1 SWR and above 10 MHz. These considerations apply to any input-end matching system.

To summarize: If you are running maximum legal power and using RG-213 or similar cable, I *do not* recommend that you use an antenna tuner or any other matching device at the transmitter end of a line to correct an SWR that exceeds 4:1. If your SWR is higher than that, you need to do some work on the antenna or the matching device at its end of the line!

The bandwidth of acceptable SWR is another important thing to consider for this application. The higher the SWR on the line, the greater will be the effect of the individual elements in the matching network at a specific frequency. This means that the effects of frequency variations will be more pronounced, and the bandwidth over which reasonable SWR correction can be obtained will be more limited. However, the overriding bandwidth

effect will usually be that caused by the variation of the input impedance of the line. This is due to changing load (antenna) characteristics and the changing electrical length of the line as the frequency is varied. Because each antenna system has its own characteristics, it's impossible to generalize about this problem. I've found that with most antennas, the frequency ranges over which the SWR is acceptable are about the same with the networks in operation as they are in different parts of the same bands where the lines are properly matched. One exception to this is my 40-meter Yagi, on which the parasitic elements are optimized for the CW band. The self-resonant frequency of the director is quite near the upper end of the phone band, and the input impedance of the line varies rapidly as I approach that end of the band. So with a matching network designed to optimize the SWR in the phone segment, the bandwidth of acceptable SWR is slightly less than the entire phone band.

The calculation of the network elements' reactances, whether by the formulas or the computer program, first requires that the input impedance (resistance and reactance) of the line be measured fairly accurately. Do this at the frequency for which the SWR is to be corrected. To make the measurement you'll need either an RF impedance bridge (like the one described in the *ARRL Handbook* and the *ARRL Antenna Book*) or a high-quality noise bridge calibrated for reactance measurements. I've used both with good results, but you can use the noise bridge only when the frequency of interest is very quiet, so that the null is unmistakable.

Make the measurement at the exact point in the line where the matching network is to be inserted. Use any convenient length of cable from the network back to the transmitter. This cable length can be changed, but the length of the line between the antenna and the matching device must remain the same.

Formulas for calculating the L-match

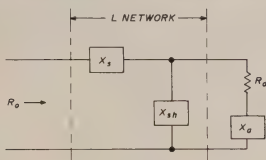
An L-network consists of just two elements — a series element and a shunt element. The shunt element may be on the load side or the generator side of the series element, but there are certain conditions under which only one of these configurations provides valid solutions.

In the derivation of the formulas (shown in **figs. 1 and 2**), the desired impedance as viewed from the generator (transmitter) side is designated as R_0 . The derivations assume that this impedance is to be purely resistive. The impedance of the load (the input to the coaxial cable terminated at its far end by the antenna) will have a resistive component (always positive), designated as R_a , and a reactive component (positive, negative, or in some cases zero), designated as X_a . The shunt element of the network is designated as X_{sh} .

Figure 1 shows the derivation of the formulas for the

first configuration in which the shunt element is on the antenna side of the series element. The transmitter is connected through the series element to the parallel combination of the shunt element and the load. The real components are extracted to form one equation from the complex algebra expression of this circuit. The

FIGURE 1



R_o , the impedance seen by the transmitter, is the parallel combination of $R_a + jX_a$ and jX_{sh} , in series with jX_s :

$$R_o = jX_s + \frac{jX_{sh}(R_a + jX_a)}{R_a + j(X_a + X_{sh})}$$

This can be restated as:

$$R_o R_a + j(R_o X_a + R_o X_{sh}) = jR_a X_s - X_a X_s - X_s X_{sh} + jR_a X_{sh} - X_a X_{sh}$$

From the real terms:

$$X_s = - \frac{R_o R_a + X_a X_{sh}}{X_a + X_{sh}}$$

From the imaginary terms, substituting the above for X_s : $(R_o - R_a)X_{sh}^2 + 2R_o X_a X_{sh} + (R_o X_a^2 + R_o R_a^2) = 0$

Solving for X_{sh} by the quadratic formula:

$$X_{sh} = \frac{R_o X_a \pm \sqrt{R_o^2 X_a^2 + (R_a - R_o)(R_o X_a^2 + R_o R_a^2)}}{R_a - R_o}$$

For either configuration, if X_s or X_{sh} (denoted as X below) is positive, calculate its inductance as follows, with F in kHz:

$$L = \frac{1000X}{6.28F} \mu H$$

If X_s or X_{sh} is negative, calculate its capacitance as follows:

$$C = \frac{-10^9}{6.28FX} pF$$

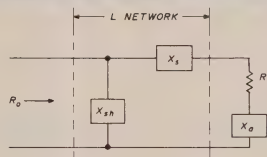
Derivation of formulas for first configuration.

imaginary components that remain (with the "j" operators dropped) constitute a separate equation. The first equation is solved to get a formula for X_s , the series element. This formula can't yet be used for final calculation of X_s because it involves X_{sh} , which is still unknown at this point.

Next the equation derived from the imaginary components is solved for X_{sh} . The expression for X_s is substituted where X_s appears in this equation. This gives a quadratic equation for X_{sh} , which is solved by the quadratic formula to give X_{sh} in terms of the known resistances and reactances. After X_{sh} is calculated, X_s can be determined from the first formula.

There are always two mathematical solutions for X_{sh} , as indicated by the plus and minus signs before the square root. However, the configuration doesn't have a valid (real) solution for combinations of the variables that lead to a negative quantity under the square root sign. In such cases, the configuration is not physically realizable and can't be used.

FIGURE 2



R_o , the impedance seen by the transmitter, is jX_{sh} in parallel with the series combination of $R_a + jX_a$ plus jX_s :

$$R_o = \frac{jX_{sh}(R_a + jX_a + jX_s)}{R_a + j(X_a + X_s + X_{sh})}$$

This can be restated as:

$$R_o R_a + jR_o(X_a + X_s + X_{sh}) = -X_a X_{sh} - X_s X_{sh} + jR_a X_{sh}$$

From the real terms:

$$R_o R_a = -X_a X_{sh} - X_s X_{sh}$$

or

$$X_s = - \frac{R_o R_a}{X_{sh}} - X_a$$

From the imaginary terms, substituting the above for X_s :

$$(R_o - R_a)X_{sh}^2 - R_o^2 R_a = 0$$

Solving for X_{sh} by the quadratic formula gives:

$$X_{sh} = \pm R_o \sqrt{\frac{R_a}{R_o - R_a}}$$

Use the formulas for L and C as given in fig. 1.

Derivation of formulas for second configuration.

Satellite Tracking

with your PC and the Kansas City Tracker & Tuner



The **Kansas City Tracker** is a hardware and software package that connects between your rotor controller and an IBM XT, AT, or clone. It controls your antenna array, letting your PC track any satellite or orbital body. The **Kansas City Tracker** hardware consists of a half-size interface card that plugs into your PC. It can be connected directly to a Yaesu/Kenpro 5400A/5600A rotor controller. It can be connected to other rotor assemblies using our Rotor Interface Option.

The **Kansas City Tuner** is a companion product that is used in satellite work. It can provide automatic doppler-shift compensation for digital satellite work. Using our new **F-Trak** feature it can also slave the uplink radio frequency to the downlink radio's frequency. The **Tuner** is compatible with most rigs including Yaesu, Kenwood, and Icom. It controls your radio thru its serial computer port (if present) or through the radio's up/down mic-click interface.

The **Kansas City Tracker** and **Tuner** include custom serial interfaces and do not use your computer's valuable COMM ports. The software runs in your PC's "spare time," letting you run other programs at the same time.

The **Kansas City Tracker** and **Tuner** programs are "Terminate-and-Stay-Resident" programs that attach themselves to DOS and disappear. You can run other DOS programs while your antenna tracks its target and your radios are tuned under computer control. This unique feature is especially useful for digital satellite work; a communications program like PROCOMM can be run while the PC aims your antennas and tunes your radios in its spare time. Status pop-up windows allow the user to review and change current and upcoming radio and antenna parameters. The KC Tracker is compatible with DOS 2.00 or higher and will run under DESQ-VIEW.

Satellite and EME Work

The **Kansas City Tracker** and **Kansas City Tuner** are fully compatible with AMSAT's QUIKTRAK (3.2) and with Silicon Solution's GRAFTRAK (2.0). These programs can be used to load the **Kansas City Tracker's** tables with more than 50 satellite passes. We also supply assembled & tested TAPR PSK modems with cases and 110v power supplies.

DX, Contests, and Nets

Working DX or contests and need three hands? Use the **Kansas City Tracker** pop-up to work your antenna rotor for you. The **Kansas City Tracker** is compatible with all DX logging programs. A special callsign aiming program is included for working nets.

Packet BBS

The **Kansas City Tracker** comes complete with special control programs that allow the packet BBS user or control-op to perform automated antenna aiming over an hour, a day, or a week. Your BBS or packet station can be programmed to automatically solicit mail from remote packet sites.

Vision-Impaired Hams

The **Kansas City Tracker** has a special morse-code sender section that will announce the rotor position and status automatically or on request. The speed and spacing of the code are adjustable.

The **Kansas City Tracker** and **Tuner** packages include the PC interface card, interface connector, software diskette, and instructions. Each Kansas City unit carries a one year warranty.

- KC Tracker package for the Yaesu/Kenpro 5400A/5600A controller \$189
- Interface cable for Yaesu/Kenpro 5400A/5600A \$ 19
- KC Tracker package with Rotor Interface Option (to connect to ANY rotors) \$219
- KC Tuner (must be purchased with KC Tracker) \$ 79
- Assembled & tested TAPR PSK modem with case & 110v power supply \$219
- AMSAT QuikTrak software \$ 75

Visa and MasterCard accepted.

Shipping and handling: \$5, \$20 for international shipments. Prices subject to change without notice.

L. L. Grace

Communications Products

41 Acadia Drive • Voorhees, NJ 08043 • U.S.A.

For more info: Telephone 609-751-1018
CompuServe 72677,1107

In **fig. 2** an identical procedure is used to derive the formulas for the second configuration, in which the shunt reactance is on the transmitter side of the series element. Again there are two mathematically valid solutions, and again there are combinations of variables for which there is no real solution. This configuration has real solutions only when R_a , the resistive component at the cable input, is less than R_o , the resistive load to be seen by the transmitter.

Despite the range of variables for which there is no usable solution in one or the other of the configurations, one of them always has a real solution for a given set of variables. In many cases both configurations are applicable, and for such cases there are four different possible combinations of reactive elements to choose from.

Generally, the best choice is the one involving the most practical values of inductance and capacitance. From the standpoint of physical size and losses, a lower value of inductance is preferable to a higher one. For harmonic attenuation, a combination using shunt capacitance and series inductance is preferable to one using shunt inductance and series capacitance.

The L-match computer program

The computer program (**fig. 3**) uses the formulas derived in **figs. 1 and 2** to compute the reactance values and corresponding capacitances and inductances in all the usable configurations for a given set of conditions. The program is written in GW-BASIC and should run successfully on any IBM-compatible personal computer.

The two configurations are examined in turn. The first to be examined is the one with the shunt reactance on the antenna side of the series reactance (the first configuration). An error-trapping routine detects situations in which the square-root calculation would involve a negative quantity, or where there is an attempted division by zero. In these situations there is no real solution for the configuration. The error-trapping routine reports this fact and routes the program to the calculation of the second configuration, for which similar error trapping is provided.

As the reactances for each case are determined, a subroutine (lines 3000 through 3110) checks their values by using them to calculate and display the impedance seen by the transmitter with the matching network in place. Line 3080 compensates for small rounding and computing inaccuracies (up to 0.1 percent) in comparing the resistive component of the result with the desired resistive load. In the result, line 3090 rounds to zero any final reactive component of less than 0.1 percent of the resistive component. If single-precision computation were used, these inaccuracies (which occur primarily in the checking routine) might exceed the limits in rare cases where the computations involve small differences in large quantities. All computation is done in double-precision.

But the checking routine is correspondingly accurate only if the program is run with BASIC loaded with the double-precision transcendental math package (BASIC/D) that improves the precision of the trigonometric functions used. If you don't use BASIC/D, a reactive component exceeding 0.1 percent of R_o (but still negligible) may appear in rare cases in the check result.

In any case, results stated in single precision are more than adequate for your purposes. So all computed values to be displayed are converted to single-precision numbers before they are presented.

Some practical L-network matching devices

In the networks I'll describe, all parts except the miniboxes are from flea markets or my junkbox.

I avoid using variable capacitors because they're bulky, expensive, and hard to find. Also, once you've determined the capacitance, no further change is required in this application.

When winding the coils, I estimate the number of turns required from the formulas given in the *ARRL Handbook*, and then wind about 20 percent more. With the network completed (except for final connection of a flexible lead to one end of the coil), I install the device in the line and connect it directly at the output of my SWR meter. Using very low power at the design frequency, I move the lead across the coil to find the tap point that gives minimum SWR. The minimum is usually quite close to 1:1; if it's not, I may need to do some trimming of the capacitance by adding small values in parallel with it or changing to a slightly lower value. When I find the proper combination, I solder the tap and clip off most of the unused coil turns. Before removing all the unused turns, I check the final combination with the box cover installed. Sometimes the coil inductance is lowered by the proximity of the shielding, and the final coil may require an additional turn or two to provide the same inductance as with the cover off.

I have also used manufactured coils (e.g., Miniductors) with equal success. The *ARRL Handbook* also gives information for estimating the inductance of these coils for different diameters and turns per inch.

160-meter dipole

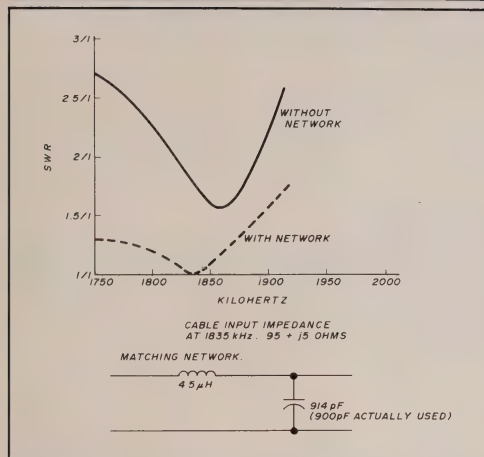
Figure 4 shows the original SWR curve at the input end of the 50-ohm line to my 160-meter dipole. The minimum SWR is 1.6:1 at 1860 kHz. I normally confine my 160-meter operation to the CW and DX portions of the band (1800 to 1850 kHz). I do most of my operating around 1835 kHz. The SWR on this frequency is 1.8:1. It's actually impossible to tune the amplifier properly with this antenna, because the range of its loading capacitor is severely limited by the heavy padding it requires on this band. As a result, it runs out of range very quickly as the load impedance departs from 50 ohms resistive.


```

1000 RO=0:RA=0:XA=0:XSH=0:XS=0:DEFDBL A-Z
1010 CLS:INPUT"FREQUENCY (KHZ)";F
1020 INPUT "DESIRED LOAD RESISTANCE";RO
1030 INPUT "RESISTANCE LOOKING TOWARD ANTENNA";RA
1040 INPUT "REACTANCE LOOKING TOWARD ANTENNA";XA:PRINT
1050 IF RA=RO THEN PRINT TAB(5)"NO SHUNT REACTANCE REQUIRED":XS=-XA:PRINT:GOSUB
2030:GOTO 4500 'Special Case. Calculate XS and go directly to end.
1060 PRINT "WITH SHUNT REACTANCE ON ANTENNA SIDE OF SERIES REACTANCE:"
1070 ON ERROR GOTO 4000 'Set up error trapping for next calculation
1080 XSH=((RO*XA)-(SQR(((RO^2*XA^2))+((RA-RO)*((RO*XA^2)+(RO*RA^2))))))/(RA-RO)
'Calculate shunt reactance for first case, first configuration
1090 GOSUB 2000:GOSUB 3020 'Calculate series element, display results and
check them
1100 PRINT"OR:";
1110 ON ERROR GOTO 4010 'Set up error trapping for next calculation
1120 XSH=((RO*XA)+(SQR(((RO^2*XA^2))+((RA-RO)*((RO*XA^2)+(RO*RA^2))))))/(RA-RO)
'Calculate second case, first configuration
1130 GOSUB 2000:GOSUB 3020 'See remarks for 1090
1140 PRINT:PRINT "WITH SHUNT REACTANCE ON TRANSMITTER SIDE OF SERIES REACTANCE:"
1150 ON ERROR GOTO 4020 'Set up error trapping for second configuration
1160 XSH=RO*(SQR((RA)/(RO-RA))):XS=-(RO*RA/XSH)-XA 'Calculate first case, 2nd
configuration
1170 GOSUB 2010:GOSUB 3000 'Calculate inductance and capacitance, display
results and check them
1180 PRINT"OR:";
1190 XSH=-XSH:XS=-(RO*RA/XSH)-XA 'Calculate second case,second configuration
1200 GOSUB 2010:GOSUB 3000 'See remarks for 1170
1210 PRINT:GOTO 4500
2000 XS=-(RO*RA)+(XA*XSH))/(XA+XSH) 'Calculate series reactance, first
configuration
2010 X=XSH:IF X>0 THEN GOSUB 2510:X!=X:PRINT TAB(5)"Shunt Inductive Reactance is
";X!;" ohms (";L!;CHR$(230);"H)" 'If shunt reactance is inductive, go calcu-
late inductance and display both in single precision
2020 IF X<0 THEN GOSUB 2500:X!=X:PRINT TAB(5)"Shunt Capacitive Reactance is ";X!
;" ohms (";C!;"pFd)" 'If shunt reactance is capacitive, go calculate capaci-
tance and display both in single precision
2030 X=XS:IF X<0 THEN GOSUB 2500:X!=X:PRINT TAB(5)"Series Capacitive Reactance i
s ";X!;"ohms (";C!;"pPd)" 'Same procedure as for shunt element (line 2020)
2040 IF X>0 THEN GOSUB 2510:X!=X:PRINT TAB(5)"Series Inductive Reactance is ";X!
;"ohms (";L!;CHR$(230);"H)" 'Same procedure as for shunt element (line 2010)
2050 IF X=0 THEN PRINT TAB(5)"No Series Reactance Required" 'Special case
2060 IF RO=RA THEN PRINT TAB(10)"(Transmitter sees ";RO;"ohms resistive.)"
'Special case
2070 RETURN
2500 C=-LE+O9/(2*3.141593*F*X):C!=C:RETURN 'Calculate capacitance and convert
to single precision
2510 L=X*1000/(2*3.141593*F):L!=L:RETURN 'Calculate inductance and convert
to single precision
3000 Z=SQR(((RA^2*XSH^2)+(XSH^2*(XA+XS)^2))/(RA^2+(XA+XS+XSH)^2)) 'Calculate
magnitude of impedance at network input (second configuration)
3010 A=ATN(-(RA/(XA+XS)))-ATN((XA+XS+XSH)/RA):XS=0:GOSUB 3080:RETURN 'Calculate
phase angle of impedance at network input. Continue at 3080
3020 Z=SQR(((XA^2*XSH^2)+(RA^2*XSH^2))/(RA^2+(XA+XSH)^2)) 'Calculate magnitude
of impedance beyond series element (first configuration)
3030 IF XA=0 THEN R1=-3.141593/2:GOTO 3050 'Avoid division by zero in next step
3040 R1=ATN(-(RA/XA)) 'Get phase angle of numerator, first configuration
3050 R2=ATN((XA+XS)/RA) 'Get phase angle of denominator, first configuration
3060 A=R1-R2 'Phase angle of input impedance, first configuration
3070 IF COS(A)<0 THEN R1=3.141593+R1:GOTO 3060 'Check for ambiguity in arctan
calculations and correct if necessary
3080 ZRE=Z*COS(A):IF ZRE<0 THEN ZRE=RO*1.001 THEN ZRE!=RO ELSE ZRE!=ZRE
'Calculate resistive component and ignore inaccuracies under 0.1 percent
3090 ZIM=(Z*SIN(A))+XS:IF ABS(ZIM)<.001*RO THEN ZIM=0:PRINT TAB(10)"(Transmitter
sees";ZRE!;"ohms resistive.)":RETURN 'Calculate reactive component, add series
element. If total is under 0.1 percent of RO round to zero and print results.
3100 ZIM!=ZIM:PRINT TAB(10)"(Transmitter sees ";ZRE!;"j";ZIM!;"ohms.)" 'If
reactive component is significant, print check result in complex notation
3110 RETURN
4000 IF ERR=5 OR ERR=11 THEN PRINT TAB(5)"No First-Case Solution":PRINT:RESUME 1
110 'Error handling for first case, first configuration
4010 IF ERR=5 OR ERR=11 THEN PRINT TAB(5)"No Second-Case Solution":PRINT:RESUME
1140 'Same for second case, first configuration
4020 IF ERR=5 OR ERR=11 THEN PRINT TAB(5)"No Solution for This Configuration":RE
SUME 4500 'Same for second configuration
4500 LOCATE 23,1,0:PRINT"CALCULATE ANOTHER (Y OR N)?:K$=INKEY$:IF K$=""THEN 450
0
4510 IF K$="Y"OR K$="y"THEN 1000 ELSE END

```

Program in GW-BASIC for calculation of L-match configurations. For maximum accuracy in the checking routine (lines 3000 through 3100) the program should be run under BASIC loaded with the double-precision transcendental math package (load BASIC/D instead of normal BASIC).

FIGURE 4

SWR curves and matching network for 160-meter dipole.

Measuring the input impedance of the line at 1835 kHz shows 95 ohms resistance (R_a) and a small amount (estimated as 5 ohms) of inductive reactance (X_a). The computer calculation shows that a network with 4.5 μ H of series inductance and 914 pF of shunt capacitance would provide a match to 50 ohms.

The shunt capacitor in my device is a 700-pF mica transmitting capacitor from a war surplus TU-10B tuning unit. It has a 200-pF high-voltage disk ceramic in parallel to give 900 pF. This is close to the calculated 914 pF — closer, in fact, than the probable accuracy of the measurements.

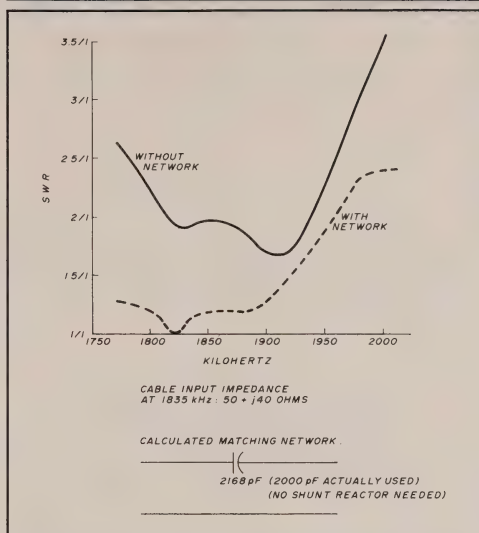
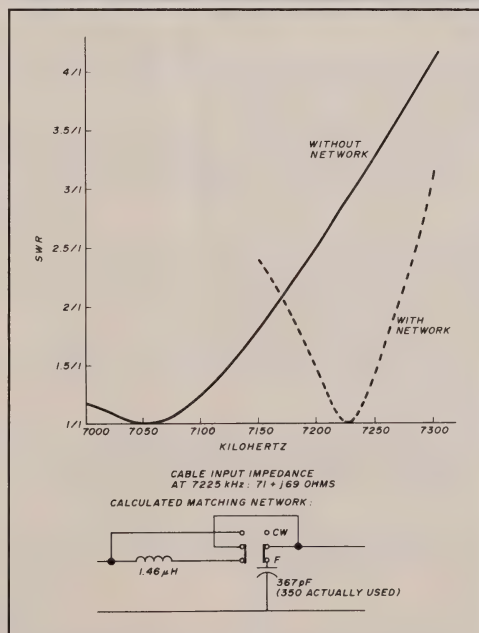
The coil in this unit is wound of no. 12 soft-drawn bare copper wire using a piece of 1-inch PVC pipe as a mandrel. Wire this large isn't necessary, but I had it on hand. It makes a coil that's virtually self-supporting, and it's easy to solder a tap anywhere on the bare wire.

The SWR curve taken with the final network in place shows a perfect 1:1 at the design frequency of 1835 kHz, and a major improvement in the SWR seen by the transmitter over the entire range from 1800 to 1900 kHz. This network is permanently connected in the line and not equipped with a by-pass switch, as are some of the others I'll describe.

Quarter-wave 160-meter sloper

Figure 5 shows a network consisting of a single capacitor, which I use to correct the SWR of the line to a quarter-wave 160-meter sloper.

At first, there was no sign of resonance or a match to the cable anywhere in the band with the sloper alone in its original installation on a 70-foot tower. The SWR was extremely high — a disappointing but common situation

FIGURE 5

SWR curves and L-network for 160-meter sloper.
FIGURE 6

SWR curves and L-network for 40-meter Yagi.

ATTENTION: WOMEN WHO SOUGHT EMPLOYMENT WITH THE VOICE OF AMERICA (VOA), THE UNITED STATES INFORMATION AGENCY (USIA), OR THE UNITED STATES INTERNATIONAL COMMUNICATION AGENCY (USICA) BETWEEN OCTOBER 8, 1974 AND NOVEMBER 16, 1984.

**YOU MAY BE A VICTIM OF SEX DISCRIMINATION
ENTITLED TO A MONETARY AWARD AND A POSITION WITH THE AGENCY.
UNITED STATES DISTRICT COURT FOR THE DISTRICT OF COLUMBIA**

CAROLEE BRADY HARTMAN, et al.,
Plaintiffs,
v.
CHARLES Z. WICK,
Defendant

Civil Action No. 77-2019
Judge Charles R. Richey

PUBLIC NOTICE

On November 16, 1984, the United States District Court for the District of Columbia found in this class action lawsuit that the United States Information Agency (USIA or the Agency), including the Voice of America (VOA), is liable for sex discrimination against female applicants for the following positions at the Agency. The USIA was also formerly known as the United States International Communication Agency (USICA). On January 19, 1988, the Court issued its opinion ordering relief in a variety of forms to potential class members. Accordingly, this case is now in the remedial phase.

JOBS COVERED

Specifically, the Court has found that the Agency has discriminated against women in hiring in the following jobs:

- Electronic Technician (Occupational Series 856)
- Foreign Language Broadcaster (Occupational Series 1048)
- International Radio Broadcaster (Other) (Occupational Series 1001)
- International Radio Broadcaster (English) (Occupational Series 1001)
- Production Specialist (Occupational Series 1071)
- Writer/Editor (Occupational Series 1082)
- Foreign Information Specialist/Foreign Affairs Specialist/Foreign Service Information Officer/Foreign Service Officer (Occupational Series 1085 and 130)
- Radio Broadcast Technician (Occupational Series 3940)

WHO IS INCLUDED

All women who sought employment with the Agency in any of the jobs listed above between October 8, 1974 and November 16, 1984 and were not hired may be eligible for relief. Also included are those women who were discouraged from applying for these positions during that time period. Even those women subsequently hired by the Agency in some capacity may be entitled to participate in the remedial phase of this case.

Women who sought employment with the Agency as Foreign Service Officers or Foreign Service Information Officers may be eligible for different kinds of relief depending upon the date of application and whether they sought employment at the entry level or mid-level. Women who sought employment with the Agency as entry level Foreign Service Officers or Foreign Service Information Officers in the years 1974-1984 must use the procedure outlined below. Women who sought employment with the Agency as mid-level Foreign Service Officers or Foreign Service Information Officers in the years 1974-1984 must also use the procedure outlined below. However, women who sought employment with the Agency as entry level Foreign Service Officers or Foreign Service Information Officers in the years 1978-1984 cannot use the procedure outlined below, since the Court has ordered an alternative form of relief for them and selected women in this group will be notified individually as to their rights.

RELIEF AVAILABLE AND HOW TO OBTAIN IT

Relief available to class members may include a monetary award and/or priority consideration for a current position with the Agency. If you think you may be entitled to relief, you must obtain a claim form, complete it fully, and return it to counsel for the plaintiff class, Bruce A. Fredrickson, Esq., Webster & Fredrickson, 1819 H Street, N.W., Suite 300, Washington, D.C. 20006 (202/659-8515), postmarked no later than July 15, 1989.

You may obtain a claim form in person and/or in writing from several sources: counsel for the plaintiff class, whose address is listed above; in person from USIA, Front Lobby, 301 14th Street, S.W., Washington, D.C. (8:15am - 5:00pm); Office of Personnel Management (OPM), Federal Job Information Center (First Floor, Room 1425), 1900 E Street, N.W., Washington, D.C. (8:30am - 2:30pm); or from area OPM offices throughout the country; in writing, VOA-Hartman, P.O. Box 400, Washington, D.C. 20044. You should carefully consider all questions on the claim form, sign it, and return it to counsel for the plaintiff class. Do not, under any circumstances, return the claim form to the Judge, the Court or the Clerk of the Court. The Judge, the Court and the Clerk of the Court will not accept the claim forms and will not forward claim forms to plaintiffs' counsel.

PROCESSING OF CLAIMS

The process for handling claims has not been finally decided. Thus far, the Court has ordered that responding class members demonstrate their potential entitlement to relief at an individual hearing to be scheduled at a later date. However, the Court has reserved the right to reconsider this procedure in the event the number of claims filed makes this approach unmanageable.

Should individual hearings be used, you will be fully informed as to the date and time of your hearing. Moreover, you will be entitled to legal representation by counsel for the plaintiff class or his designee at no cost to you. Legal counsel will discuss your claim with you prior to your hearing, help you prepare your case and represent you at your hearing. You may, of course, retain your own attorney to represent you, if you so desire.

At the individual hearing, you will be asked to demonstrate your potential entitlement to relief by showing that you applied for one or more of the covered positions during the period October 8, 1974 and November 16, 1984 and that you were rejected, or that you were discouraged from applying. Evidence may be required in the form of testimony, documents, or both. Once you have demonstrated these facts, USIA is required to prove, by clear and convincing evidence, that you were not hired (for each position for which you applied) for a legitimate, non-discriminatory reason, such as failure to possess requisite qualifications. Should USIA make such a showing, you would then be entitled to demonstrate that the Agency's reason is merely a cover for sex discrimination or unworthy of belief.

Following the hearing, the Presiding Official will decide whether you are entitled to relief and, if so, what relief is appropriate. You may be entitled to wages and benefits you would have earned if you had been hired (back pay) from the date of your rejection until the date relief is approved. Under the law, back pay is offset by earnings you may have had during the period. In addition, you may be found to be entitled to front pay (that is, compensation into the future until an appropriate position is afforded you). Similarly, you may be found to be entitled to priority consideration for employment with the Agency. If hired, you may further be entitled to retroactive seniority with the associated benefits and the value of any promotions you would likely have had if you had not suffered discrimination.

REQUIRED STEPS TO FILE YOUR CLAIM

To participate in the remedial phase, you must fully complete the claim form and return it, POSTMARKED NO LATER THAN July 15, 1989, to counsel for the plaintiff class. Your failure to do so will result in your losing all rights you may have in this lawsuit. If you have questions about your rights or procedures available to you, you may contact counsel for the plaintiff class:

Bruce A. Fredrickson
Webster & Fredrickson
1819 H Street, N.W., Suite 300
Washington, D.C. 20006
(202/659-8515)

/s/ Judge Charles R. Richey
United States District Court
Judge Charles R. Richey

October 4, 1988

Date

with quarter-wave slopers. I installed a quarter-wave counterpoise, grounded to the top of the tower, at a right angle to the sloper. By carefully trimming the lengths of both the antenna and the counterpoise, I brought the SWR to a minimum of 1.9:1 at 1830 kHz. Minimum SWR was still rather poor — 1.6:1 at 1910 kHz. Measurement of the input impedance of the cable at 1835 kHz showed very nearly 50 ohms of resistance and about 40 ohms of inductive reactance. The computer calculation showed that 2168 pF in series with the line would provide a match, with no shunt reactor. Eureka! I mounted a 0.002- μ F 2500-volt mica capacitor from the junkbox in a minibox. This "network" is shown in fig. 5, with the resulting SWR curve — a perfect 1:1 at 1820 kHz, and very low SWR from 1800 to 1900 kHz. For obvious reasons, this network is permanently installed in the line and there's no by-pass switch.

40-meter Yagi

Figure 6 shows the SWR curve at the input end of the cable to my 3-element 40-meter Yagi, which is tuned and matched for the CW portion of the band. The SWR is 1:1 at 7045 kHz, but rises radically in the phone portion of the band. At 7225 kHz, the center of the phone band, the SWR is 2.9:1. The measured input impedance of the cable at this frequency is 71 ohms of resistance and 69 ohms of inductive reactance.

For this situation, the formulas give 1.46 μ H of series inductance with 367 pF of shunt capacitance on the antenna side for a match to 50 ohms at 7225 kHz.

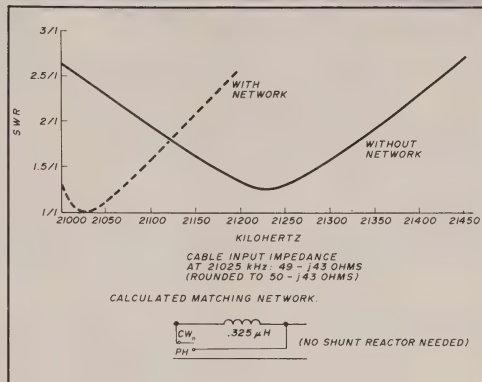
The capacitors in the resulting matching unit are two transmitting ceramic capacitors (one 200 pF and one 100 pF) and a 50-pF high-voltage disk ceramic capacitor, all connected in parallel to give 350 pF. The matching unit has a slide switch so I can by-pass it for CW operation. The SWR seen by the transmitter is 1:1 at 7225 kHz with the network in operation, but for reasons mentioned previously it rises above 2:1 beyond 7270 kHz.

15-meter Yagi

My 4-element 15-meter Yagi was originally cut and matched for a compromise between the phone and CW portions of the band. Figure 7 shows that the minimum SWR on the cable is a fairly acceptable 1.28:1 at 21,220 kHz, but rises to 2.7:1 at the high (phone) end of the band and 2.6:1 at the low (CW) end. The high SWR at the band ends presented no compensation problem for the loading capacitor used on my amplifier for this band, and I seldom operate above 21,350 kHz. Touching up the tuning on the air after first tuning into a dummy load for CW not only took extra time, but bothered my conscience as well.

Measurement of the input impedance of the cable at 21,025 kHz showed a resistive component just under

FIGURE 7



SWR Curves and L-network for 15-meter Yagi.

50 ohms (close to 49 ohms) and a capacitive reactance of about 43 ohms. One of the solutions given by calculations for the first configuration for this impedance was a series inductance of 0.324 μ H (42.9 ohms) and a shunt inductance of 32.2 μ H (a very high 4250 ohms of inductive reactance). It was apparent that I needed the shunt reactance just to raise the resistive component of the load from 49 to 50 ohms, a mere 2-percent change. Another calculation showed that with the resistive component of the load rounded to 50 ohms, a 0.325- μ H series inductor would provide a match with the shunt element omitted. This simpler network was adequate, as indicated by the resulting SWR curve. The SWR is a perfect 1:1 at 21,025 kHz and is quite low over all of the first 100 kHz of the band.

This must be one of the smallest 1-kW antenna tuners in existence! It consists of only an 8-turn 1/2-inch diameter coil and contains a 2-position rotary selector switch to by-pass the coil for phone operation.

Now when I QSY to 15-meter CW, I tune the amplifier into the dummy load, switch to the antenna with the network in, and proceed without causing any tuning QRM. It's a much better feeling!

Article D

HAM RADIO

WEATHER SOFTWARE

ACCU-WEATHER-FORECASTER is a menu driven program that allows the user to tap into ACCU-WEATHER'S extensive computerized database. Maps, graphs, pictures, charts, and narrative descriptions are just part of what can be downloaded to your computer.

Several different services are available from ACCU-WEATHER. Price varies with the service and time of day that the computer is accessed. Add \$3.50 for shipping and handling.

☐ MC-IBM \$89.95
☐ MC-MAC \$89.95

**HAM
RADIO**
GREENVILLE, NH 03048

BOOKSTORE
(603) 878-1441

New! NRI course in Cellular Telephone Installation and Servicing prepares you to succeed in today's fastest-growing communications field

Now you can get the skills you need to cash in on today's booming cellular industry as you install and test your own state-of-the-art cellular telephone.

Cellular business is big business!

In the few short years since the first commercial cellular telephone system went on-line, over 1,000,000 people have signed up for service in more than 120 cities nationwide. Today, the industry is growing at an incredibly fast 4% a month, and experts predict that by 1991, at least 85% of the United States will be covered for cellular service. Better yet, by 1993 total industry revenues will exceed \$10,000,000,000—making cellular the fastest growing electronics communications field today.

For you, that means extraordinary career and money-making opportunities. Get a fast start today with NRI's hot new course in Cellular Telephone Installation and Servicing. See how far you can go!

Help wanted! Urgent demand for field technicians who can install and test new cellular telephone equipment!

Get the skills, knowledge, and confidence to install and test cellular telephone equipment, and you can name your price in this exploding new job market. Cellular system developers, retailers, and service providers—all on the ground floor of an industry that's still so young and growing so fast—are all willing to pay a premium for anyone trained to service this brand-new equipment.

Now, with NRI, you can take full advantage of every exciting opportunity in today's—and tomorrow's—booming field of cellular communications.

Exclusive hands-on training includes high-performance mobile cellular telephone you keep

Your NRI course starts with the electronics fundamentals you need to understand and service all telephone systems, then walks you step by step through the installation, troubleshooting, and repair of popular telephone systems in use today.

But that's just the beginning. With a solid conventional phone servicing foundation behind you, you're ready to build your expert understanding of the cellular telephone systems moving fast into communities all over the U.S.

Following complete, easy-to-read guidelines, you install a full-featured mobile cellular telephone in your own car, then take it through a series of diagnostic tests to become fully acquainted with its operating functions. Best of all, if you live in an area already offering

Includes full-featured mobile cellular telephone you keep!



10-digit luminescent display with 24-digit number entry/review

Ignition sense automatically turns your phone on and off with car's ignition

Electronic lock prevents unauthorized use of your phone

22 memories including last number called

Super speed dialing and 1 digit recall

cellular coverage, NRI will help you actually go on-line with up-to-date, expert advice on choosing the best and most affordable cellular service available.

Send for your FREE catalog today

For all the details about NRI's exclusive new training, send the coupon today. You'll receive a complete catalog describing NRI's Cellular Telephone Installation and Servicing course plus NRI courses in other high-tech, in-demand fields.

If the coupon is missing, write to NRI School of Electronics, McGraw-Hill Continuing Education Center, 4401 Connecticut Avenue, Washington, DC 20008.

Send Coupon Today For Free Catalog!

NRI School of Electronics

McGraw-Hill Continuing Education Center
4401 Connecticut Ave, Washington, DC 20008

☒ CHECK ONE CATALOG ONLY

- ☐ Cellular Telephone
- ☐ Computer Electronics
- ☐ TV/Video/Audio Servicing
- ☐ Electronic Music Technology

- ☐ Data Communications
- ☐ Security Electronics
- ☐ Robotics
- ☐ Basic Electronics

For career courses approved under GI Bill
☐ check for details.

Name _____ Age _____

Street _____

City/State/Zip _____

Accredited by the National Home Study Council

20-029

NEW BOOKS

ARRL ANTENNA BOOK

by Jerry Hall, K1TD, NEW 15th Edition

The all new 15th edition of this antenna classic represents over two years of hard work by editor K1TD. It's doubled in size too --from over 300 to over 700 pages big! 950 figures and charts cover just about every subject imaginable. Some of the highlights are: Chapters on Loop antennas, multi-band antennas, low frequency antennas, portable antennas, VHF and UHF systems, coupling the antenna to the transmitter and the antenna, plus p-e-n-t-y more. Like the 1988 HANDBOOK and new OPERATING MANUAL, the new ANTENNA BOOK is going to be a smash hit. Order yours today. 15th edition 900+ pages ©1988

AR-AM Softbound \$17.95

NOVICE ANTENNA NOTEBOOK

by Doug DeMaw W1FB

Novices have long wondered what is the best all around antenna for them to install. Up until now, this was a difficult question to answer. Aimed at the newly licensed Ham, DeMaw writes for the non-engineer in clear concise language with emphasis on easy-to-build antennas. Readers will learn how antennas operate and what governs performance. Also great reading for all levels of Amateur interest. 1st Edition ©1988.

AR-NAN Softbound \$7.95

THE 1989 ARRL HANDBOOK

FOR THE RADIO AMATEUR (Avail. late Oct. 1988)

Revised and updated with the latest in Amateur technology, now is the time to order your very own copy of the world famous ARRL HANDBOOK. In addition to being the definitive reference volume for your Ham shack, there are plenty of projects for every interest in Amateur Radio — from antennas for every application to the latest state-of-the-art projects — you'll find it all in the 1989 HANDBOOK. Order now and we will ship as soon as the books arrive from the printer. They make perfect gifts for the holiday season for your hard-to-buy for Ham friends or for yourself. Over 1100 pages ©1988.

□ AR-H89 Hardbound \$20.95

N6RJ's ELECTRONIC SECOND OP

for MS-DOS computers

by Jim Rafferty N6RJ

The world famous SECOND OP is now available in a state-of-the-art computerized data base. This program, written for MS-DOS computers, is a must for DX'ers, contesters and all Amateurs interested in reliable DX communication. Data can be displayed either in columnar format or in full screen displays. Unknown callsigns can be entered and compared to the ITU callsign allocation for easy identification. There's plenty more too such as: postal rates, beam headings and QSL bureaus to name just a few. Great program to have in your shack. Order your's today ©1988 MS-DOS computers. 5 1/4 and 3 1/2 versions available Please specify on your order.

□ CB-RJ (MS-DOS Computers) \$59.95

1989 AMATEUR CALLBOOKS

(Available late November 1988)

NORTH AMERICAN EDITION

Fully updated and edited to include all the latest FCC and foreign government callsigns and addresses for Hams in North America. Includes plenty of handy operating aids such as time charts, QSL bureau addresses, census information and much more. Calls from Northern Canada to tropical Panama. Now is the time to buy a new Callbook when you'll get the most use out of your investment. ©1988

□ CB-US89 Softbound \$25.95

INTERNATIONAL EDITION

QSL's are a very important part of our hobby. All sorts of awards, including the coveted DXCC, require confirmation of contact before the award can be issued. Of special interest, addresses are being added daily for Hams in the USSR and other countries. While in no means complete, it's a start and will be of tremendous help in getting QSLs. Handy operating aids round out this super book value. ©1988

□ CB-F89 Softbound \$28.95

BUY 'EM BOTH SPECIAL
Reg. \$54.90 Only \$49.95
SAVE \$4.95

Please enclose \$3.50 shipping & handling.

(800) 341-1522
(ORDERS ONLY)

features clarifier (RTT), front panel AGC, noise blanker, all mode squelch, 20 dB attenuator, computer interface, and a clean, "operator preferred" front panel layout.

The transmitter's PA is cooled by a quiet, thermostatically controlled internal fan and is enclosed in its own diecast aluminum heat-sink chamber, which allows for full power operation in CW, SSB, FM and RTTY, AMTOR, SSTV, and Packet.

Heath offers you more.

In addition to the SB-1400, Heath offers a full line of pre-assembled or build-it-yourself amateur radio equipment to completely outfit your ham shack or upgrade your system.

You can also prepare for your next exam (Novice, Technician, General, Advanced or Extra class) with Heath study courses.

Finally, as a Heath-equipped ham, you can get answers to your technical questions from our tech consultants, who are licensed ham operators, on the Heath Tech Assistance line.

For more information on the SB-1400 or Heath's complete line of amateur radio equipment, call for a FREE catalog: 1-800-44-HEATH (1-800-444-3284)

Best to start with.
Best to stay with.

Heath Company

Benton Harbor, Michigan 49022

©1989, Heath Company.

A subsidiary of
Zenith Electronics Corporation.

Thanks for
the new
country
(Taiwan)!
Your Heath
gear sounds
great!"
K3YGU, Maryland



New! NRI course in Cellular Telephone Installation and Servicing prepares you to succeed in today's fastest-growing communications field

Now you can get the skills you need to cash in on today's booming cellular industry as you install and test your own state-of-the-art cellular telephone.

Cellular business is big business!

In the few short years since the first commercial cellular telephone system went on-line, over 1,000,000 people have signed up for service in more than 120 cities nationwide. Today, the industry is growing at an incredibly fast 4% a month, and experts predict that by 1991, at least 85% of the United States will be covered for cellular service. Better yet, by 1993 total industry revenues will exceed \$10,000,000,000—making cellular the fastest growing electronics communications field today.

For you, that means extraordinary career and money-making opportunities. Get a fast start today with NRI's hot new course in Cellular Telephone Installation and Servicing. See how far you can go!

Help wanted! Urgent demand for field technicians who can install and test new cellular telephone equipment!

Get the skills, knowledge, and confidence to install and test cellular telephone equipment, and you can name your price in this exploding new job market. Cellular system developers, retailers, and service providers—all on the ground floor of an industry that's still so young and growing so fast—are all willing to pay a premium for anyone trained to service this brand-new equipment.

Now, with NRI, you can take full advantage of every exciting opportunity in today's—and tomorrow's—booming field of cellular communications.

Exclusive hands-on training includes high-performance mobile cellular telephone you keep

Your NRI course starts with the electronics fundamentals you need to understand and service all telephone systems, then walks you step by step through the installation, troubleshooting, and repair of popular telephone systems in use today.

But that's just the beginning. With a solid conventional phone servicing foundation behind you, you're ready to build your expert understanding of the cellular telephone systems moving fast into communities all over the U.S.

Following complete, easy-to-read guidelines, you install a full-featured mobile cellular telephone in your own car, then take it through a series of diagnostic tests to become fully acquainted with its operating functions. Best of all, if you live in an area already offering

Includes full-featured mobile cellular telephone you keep!

10-digit luminescent with 24-digit num entry/review

Ignition sen automatic your pho off with ignitio

El P

Send C

NRI School
McGraw-Hill Con
4401 Connecticut

☒ CHECK ONE
☐ Cellular Tele
☐ Computer Ele
☐ TV/Video/Aud
☐ Electronic Mus

Name _____

Street _____

City/State/Zip _____

Accredited by the Natio

NEW BOOKS

PASSPORT TO WORLDWIDE RADIO 1989 Edition

Brand new and fully revised, SWL's everywhere will want a copy for their library. Expanded to 416 pages, the book now includes a bigger and better buyer's guide, an interview with James Michener, an exciting real life drama of one SWL's escape from Iran plus much more. Also includes all the latest broadcast schedules from countries around the world. You're up-to-date if you have a copy of this new book by your radio. 416 pages 1989 Edition ©1988

□ IBS-RD189

Softbound \$14.95

MASTERING PACKET RADIO: the hands on guide

by Dave Ingram K4TWJ

Packet radio continues to grow at a rate that boggles the mind. This new book appeals to all levels of packet radio enthusiasts from novices to experts alike. Full of illustrations and written in a simple, easy-to-understand style. Topics covered include: a basic primer, home computers and data communications terminals, a survey of equipment available, how to set up a station plus much more. Great compliment to the other packet books available. 208 pages ©1988 1st edition

□ Z2567

Softbound \$12.95

THE ARRL SATELLITE ANTHOLOGY

Taken from the pages of the "Amateur Satellite News" column in QST. Includes the latest information available on OSCARs 9 through 13 as well as the Russian RS satellites. Full coverage is given to Phase III, OSCAR 10 and 13 satellites. Also includes an unpublished article detailing UoSAT-OSCAR 11 operation. Digital modes, tracking, antennas, RUDAK, microcomputer processing of telemetry plus much more is contained in this valuable new volume. 112 pages ©1988

□ AR-SA

Softbound \$4.95

22nd CENTRAL STATES VHF SOCIETY CONFERENCE PAPERS

Papers in this book were submitted for the 1988 Central States VHF Society meeting. Includes: Microwave EME, predicting 144 MHz "Es" openings, matching versus noise figure trade-offs in pre-amps, 902 MHz transverter, power amplifier and antennas, how to measure your own K index plus much more. A must publication for the active VHF'er. ©1988

□ AR-22CS

Softbound \$11.95

GENIUS AT RIVERHEAD a profile of

H.H. Beverage

by Alberta Wallen

Born at the very beginning of the radio age, Harold Beverage is one of radio's pioneers. Most know him from his development of the Beverage or wave type receiving antenna. Learn about the career of this brilliant engineer in this easy-to-read biography. Starting with GE in 1917 and moving to RCA in 1920, Beverage was involved in some of the most exciting adventures of radio. Of particular interest is a reprint of the famous November 1922 QST article describing the wave antenna. Includes 35 photos. 130 pages ©1988

NH-BEV

Hardbound \$15.95

THE "GROUNDS" FOR LIGHTNING & EMP PROTECTION

by Roger Block, PolyPhaser Corporation

Here's a subject that has never really been fully covered in Amateur literature. This 116 page text contains a comprehensive analysis of proper grounding and protection against lightning and other EMP disasters. Includes information for all kinds of electronic gear: radios, telephones, computers, Ethernet, CATV, TVRO, and security systems to name just a few. Of special interest to Hams are chapters on low inductance grounds and connections, guy anchor grounding, and how to ground inside the shack. Every Ham should have a copy. 1st edition 116 pages ©1987

PP-GLPE

Softbound \$19.95

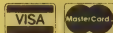
Please enclose \$3.50 shipping & handling.

HAM RADIO (603) 878-1441

GREENVILLE, N.H. 03048

DATATEL 800™

(800) 341-1522
(ORDERS ONLY)



H

uge pileups, big city QRN, no spare parts, and a long way to anywhere. You probably couldn't find a better test of the new SB-1400 All-Mode Transceiver than Heath's expedition to Taipei in the Republic of China.

When working DX, you need sensitivity to dig for the weak ones, but still need dynamic range so the guy down the block doesn't clobber you in the middle of a QSO. Sure, the SB-1400 worked the S9 + 30 signals, but out of the pile-ups it also worked a number of stateside stations running 5 watts or less! And that's not bad for a short path distance of 7600 miles!

SB-1400

A proven transceiver.

The technology that worked the world can work for you, too, in your own ham shack. The SB-1400 is a fully assembled all-band, all-mode (FM optional), continuous duty, 100-watt transceiver. It incorporates an impressive general coverage receiver with dual VFOs for split operation and 20 memories to store your favorite frequencies. The unit includes standard SSB filter plus a narrowband 500 Hz CW filter and wideband AM filter. It also

features clarifier (RIT), front panel AGC, noise blanker, all mode squelch, 20 dB attenuator, computer interface, and a clean, "operator preferred" front panel layout.

The transmitter's PA is cooled by a quiet, thermostatically controlled internal fan and is enclosed in its own diecast aluminum heat-sink chamber, which allows for full power operation in CW, SSB, FM and RTTY, AMTOR, SSTV, and Packet.

**"Thanks for
the new
country
(Taiwan)!
Your Heath
gear sounds
great!"**

K3YGU, Maryland

Heath offers you more.

In addition to the SB-1400, Heath offers a full line of pre-assembled or build-it-yourself amateur radio equipment to completely outfit your ham shack or upgrade your system.

You can also prepare for your next exam (Novice, Technician, General, Advanced or Extra class) with Heath study courses.

Finally, as a Heath-equipped ham, you can get answers to your technical questions from our tech consultants, who are licensed ham operators, on the Heath Tech Assistance line.

For more information on the SB-1400 or Heath's complete line of amateur radio equipment, call for a FREE catalog: **1-800-44-HEATH**
(1-800-444-3284)

Best to start with.
Best to stay with.

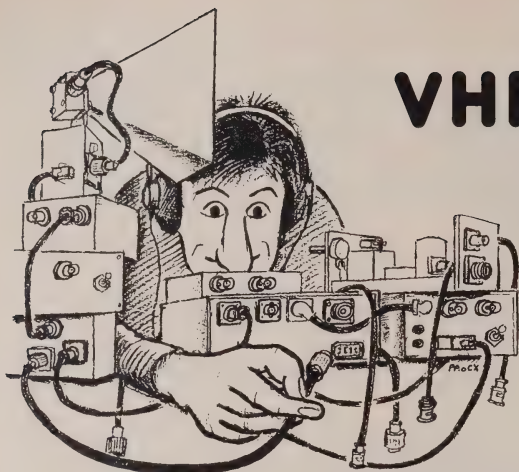
Heath Company

Benton Harbor, Michigan 49022

©1989, Heath Company.

A subsidiary of
Zenith Electronics Corporation.





VHF/UHF WORLD

Joe Reisert, W1JR

10 GHz

For some time, a 3-cm EME contact has been considered one of the last big EME "plums." As I mentioned in a recent column, several stations have been diligently working towards that goal.³ Several one-way contacts have been reported, but the two-way contact eluded most aspirants.

Well, it finally happened, and by a different group than was reported in **reference 3**. Several schedules had been run during August, but bad weather ruined the final contact because water vapor is an attenuator at these frequencies.⁴

Finally on August 27, 1988 at 0935 UTC an EME contact was completed on approximately 10.368 GHz between Greg Raven, KF5N, and Kent Britain, WA5VJB, operating under the callsign WA5VJB from Grand Prairie, Texas (EM12LQ) and Dave Chase, KY7B and Jim Vogler, WA7CJO operating under the callsign WA7CJO from Cave Creek, Arizona (DM33XL) over a terrestrial distance of about 868 miles (1937 km).

Signals were Q5 but weak and broad, almost auroral in quality, and spread out over perhaps 1 kHz (probably due to libration fading). Because most of the schedules were conducted with the moon south of the path, doppler was observed up to ± 20 kHz. Both stations aimed their antennas by peaking on "moon noise," which ran close to 1 dB.

The WA5VJB station used a 12-foot dish with a linear polarized waveguide splasher feed that can be rotated to align polarity on the incoming signal. Kent estimated the dish gain to be 49 dBi with a beam width of 0.56 degrees (this gain figure may be optimistic). The transmitter delivered 50 watts of output from a surplus TWT. The receiver was a modified SSB Elec-

DX records on 50 MHz and above: part 2

Last month's column¹ discussed how VHF/UHF and above DX records are made, and their relative importance to Amateur Radio and the state of the art (SOA). I also reviewed some of the most recent record-breaking contacts using ionospheric and tropospheric propagation.

This month I'll continue along on the same subject with emphasis on EME and tropospheric propagation records. The updated DX record tables will appear at the end of the column.

EME

There are still lots of challenges to using EME communications. Although the EME DX records on 144, 432, and 1296 MHz extend virtually halfway around the world, other bands are wide open for increased DX records.

As you'll see shortly, some of these opportunities have not gone unnoticed. Records and technology march on, but don't be discouraged. If you look at the EME records you'll find some interesting opportunities for getting into the record tables.

50 MHz

For over a decade, 6-meter EME was in the doldrums. However, as I've reported in "VHF/UHF World" lately, that interest has not only been rekindled — it has proliferated — and

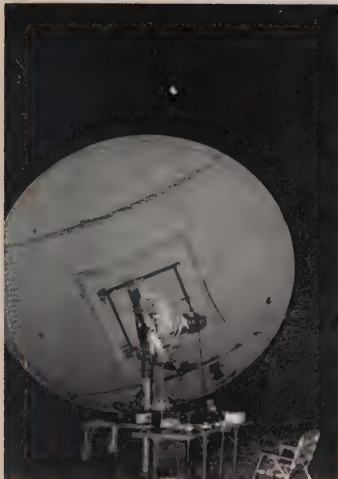
several new stations have joined the fun.

Stations outside North America are now active. The most recent station to participate is Graham Jonas, ZL2BGJ, near Wellington, New Zealand (RF70DX). He's built a huge multiwire rhombic antenna with an estimated gain of 25 dB. The antenna's radiation center intercepts the moon whenever it passes through about 16.5 degrees north declination and 130 degrees Greenwich Hour Angle. This rhombic can be steered a few degrees if necessary.

ZL2BGJ's first big 6-meter EME test was on September 7, 1988 between 1800 and 1815 UTC when he worked Jim Treybig, W6JKV, Los Altos Hills, California (CM87WI) for a new world record of 6704 miles (10,787 km). Graham was running about 650 watts. Jim was running 1500 watts to a quad of 10-element M² Yagis, each on a 52-foot boom.

The following day (September 8, 1988), Graham ran a schedule with Ray Rector, WA4NJP, Gillsville, Georgia (EM84DG) between 1900 and 1915 UTC and they completed a contact extending the worldwide DX record to 8258 miles (13,288 km). Ray was running 1500 watts to a quad of 8-element W1JR-type Yagis, each on a 34-foot boom.² I propped a similar 8-element Yagi up on a small tower and was able to hear portions of both sides of this contact.

PHOTO A



The 12-foot dish at station WA5VJB used for the first ever two-way Amateur contact on 10-GHz EME.

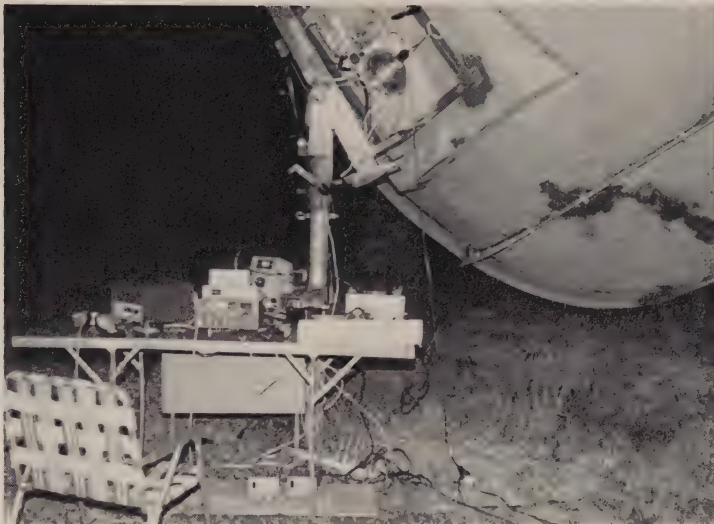
tronics transverter preceded by five stages of low-noise Avantek AT-13135 GaAsFETs that downconvert to 144 MHz. The overall system noise figure is approximately 2.1 dB. Some of the station equipment is shown in **photos A, B, and C.**

The WA7CJO station used a 16-foot dish with an estimated gain of 51 dBi and a beam width of 0.42 degrees with a scalar feed. The transmitter ran 85 watts of output power from a surplus TWT. The receiver was completely homebrew, with an image rejection mixer feeding a 28-MHz IF. The preamplifier was similar to WA5VJB's with an overall system noise figure of 1.5 dB.

A few weeks after the first-ever 3-cm Amateur EME contact was completed, I received a telephone call from Rick Fogle, WA5TNY. He reported that Lucky Whitaker, W7CNK/5, Oklahoma City, Oklahoma (EM15FI) had also completed a two-way contact on 10.368-GHz EME with WA7CJO on September 25, 1988.

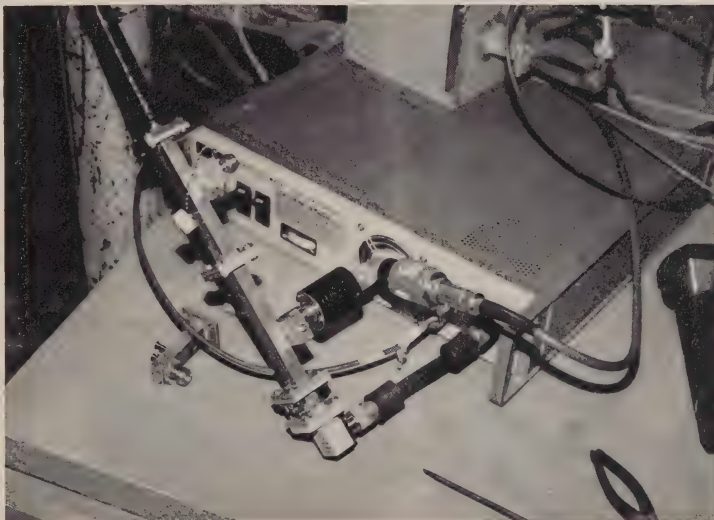
Lucky runs 32 watts from a solid-state amplifier to a 16-foot fiber glass TVRO dish.³ Lucky and Rick now feel

PHOTO B



Gear set up in the backyard just below the dish.

PHOTO C



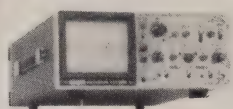
The TWT power amplifier connected to the waveguide feedline.

that, due to surface inaccuracies, the performance of his dish probably puts him in the class of an equivalent 11-foot dish with good surface accuracy.

On September 26th Rick completed

not one, but two, contacts with WA7CJO. Rick is located in Grapevine, Texas (EM12KV) and runs 14 watts from a solid-state amplifier. Rick recently upgraded to a 10-foot "spun

HITACHI SCOPES AT DISCOUNT PRICES



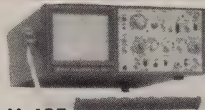
V-212

\$399

List \$560
Save \$161

20MHz Dual Trace Oscilloscope

All Hitachi scopes include probes, schematics and Hitachi's 3 year warranty on parts and labor. Many accessories available for all scopes.



V-425

List \$995

\$835

- DC to 40MHz
- Dual Channel
- CRT Readout
- Cursor Meas
- DC Offset
- Alt Magnifier
- Compact Size



V-1060

List \$1595

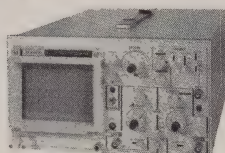
\$1,285

- DC to 100MHz
- Dual Channel
- Delayed Sweep
- CRT Readout
- Sweep Time
- Autoranging
- Trigger Lock
- 2mV Sensitivity

V-223 20MHz	D.T., 1mV sens, Delayed Sweep, DC Offset, Vert Mode Trigger	\$170	PRICE	SAVE
V-422 40MHz	D.T., 1mV sens, DC Offset Vert Mode Trigger, Alt Mag	\$875	\$695	\$75
V-423 40MHz	D.T., 1mV sens, Delayed Sweep, DC Offset, Alt Mag	\$955	\$795	\$160
V-660 60MHz	D.T., 2mV sens, Delayed Sweep, CRT Readout	\$1,195	\$990	\$205
V-1065 100MHz	D.T., 2mV sens, Delayed Sweep, CRT Readout, Cursor Meas	\$1,895	\$1,670	\$225
V-1100A 100MHz	Q.T., 1mV sens, Delayed Sweep, CRT Readout, DVM, Counter	\$2,295	\$1,995	\$300
V-1150 150MHz	Q.T., 1mV sens, Delayed Sweep, Cursor Meas, DVM, Counter	\$3,100	\$2,565	\$535

ELENCO PRODUCTS AT DISCOUNT PRICES

20MHz Dual Trace Oscilloscope



\$359

MO-1251

- 6" CRT
- Built in component tester
- TV Sync
- X-Y Operation

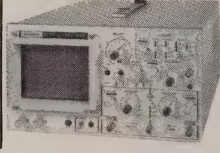
FREE DMM
with purchase of
MO-1251/1252 Scope

SCOPE PROBES

P-1 65MHz, 1x, 10x	\$19.95
P-2 100MHz, 1x, 10x	\$23.95

Fits all scopes with BNC connector

35MHz Dual Trace Good to 50MHz



\$495

MO-1252

- High luminance 6" CRT
- 1mV Sensitivity
- 6KV Acceleration Voltage
- 10ns Rise Time
- X-Y Operation + Z Axis
- Delayed Triggering Sweep

Top quality scopes at a very reasonable price. Contains all desired features. Two 1x, 10x probes, diagrams and manual. Two year guarantee.

Autoranging DMM

M-5000

\$45



- 9 Functions
- Memory and Data hold
- 1/2 % basic acc
- 3 1/2 digit LCD

True RMS 4 1/2 Digit Multimeter

M-7000

\$135



- .05% DC Accuracy
- .1% Resistance with Freq. Counter and deluxe case

Multimeter with Capacitance and Transistor Tester

CM-1500

\$55



- Reads Volts, Ohms, Current, Capacitors, Transistors and Diodes with case

Digital Capacitance Meter

CM-1550

\$58.95



- 9 Ranges
- .1pf-20,000ufd
- .5% basic accy
- Zero control with case

Digital LCR Meter

LC-1800

\$138



- Measures Coils 1uH-200H
- Caps .1pf-200uf
- Res .01-20M

AC Clamp-On Current Adapter

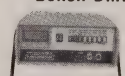
ST-265

\$22



- 0-1000A AC
- Works with most DMM

Bench DMMs



M-3500

- 3 1/2 digit
- .1% accy

M-4500

- 4 1/2 digit
- .05% accy

\$125

\$175

50MHz Logic Probe

LP-700

\$23



Logic Pulsar LP-600 \$23

Solderless Breadboards

- 9430 1,100 pins **\$15**
- 9434 2,170 pins **\$25**
- 9436 2,860 pins **\$35**
- All have color coded posts

9436 SHOWN

Low Cost Multimeter

M-1600

\$25



- 3 1/2 digit LCD
- 1% DC Accy
- 10A Scale
- Auto zero /polarity

Wide Band Signal Generators

SG-9000 \$129

- RF Freq 100K-450MHz
- AM Modulation of 1KHz
- Variable RF output

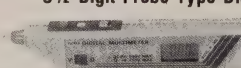


SG-9500 with Digital Display and 150MHz built-in Freq Ctr \$249

3 1/2 Digit Probe Type DMM

M-1900

\$41

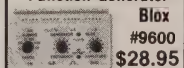


- Convenient one hand operation
- Measures DCV, ACV, Ohms
- Audible continuity check, Data hold
- with batteries and case

Function Generator Blox

#9600

\$28.95



- Provides sine, tri, squ wave
- From 1Hz to 1MHz
- AM or FM capability

Decade Blox

#9610 or #9620

\$18.95



- #9610 Resistor Blox 47 ohm to 1M & 100K pot
- #9620 Capacitor Blox 47pf to 10MFD

Digital Triple Power Supply

XP-765

\$249



- 0-20V at 1A
- 0-20V at 1A
- 5V at 5A

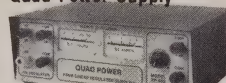
Fully Regulated, Short circuit protected with 2 Limit Cont., 3 Separate supplies

XP-660 with Analog Meters \$175

Quad Power Supply

XP-580

\$59.95



- Fully regulated and short circuit protected
- 2-20V at 2A
- 12V at 1A
- 5V at 3A
- 5V at 5A

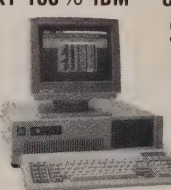
XP-575 without meters \$44.95

10MHz XT 100% IBM® Compatible

5 Year Warranty

\$595

MODEL PC-1000



- 510MHz Motherboard
- 8 Expansion Slots
- Math Compressor Slots
- 360K Floppy Drive
- AT Style Keyboard
- 150W Power Supply
- 256K RAM
- Expandable to 640K
- Monochrome Monitor
- Monographic Video Card
- Parallel Printer Port

FREE spreadsheet and word processor
3.3MS DOS and GW Basic add \$75

15 Day Money Back Guarantee

2 Year Warranty

WRITE FOR FREE CATALOG

Four-Function Frequency Counters

F-1000 1.2GH

\$259

F-100 120MH

\$179



- Frequency, Period, Totalize, Self Check with High Stabilized Crystal Oven Oscillator, 8 digit LED display

GF-8016 Function Generator with Freq. Counter

\$239



- Sine, Square, Triangle Pulse, Ramp, 2 to 2MHz
- Freq Counter .1 - 10MHz

GF-8015 without Freq. Meter \$179

WE WILL NOT BE UNDERSOLD!

UPS Shipping: US 5%

(\$10 Max) IL Res., 7% Tax



C & S SALES INC.

1245 Rosewood, Deerfield, IL 60015

(800) 292-7711 (312) 541-0710

aluminum" dish. Apparently the extra surface accuracy helped. His sun noise increased from 9.5 to 13.2 dB over that which he received from the older 10-foot TVRO-type dish he used to set the first-ever 3.4 and 5.6-GHz EME contacts.

The EME contacts made by Rick and Lucky were both just short of the distance of the WA5VJB/WA7CJO contact. There are lots of solid-state transverters out there on 10.368 GHz. Likewise, 10-foot spun aluminum dishes are available. It seems the only things holding up contacts are the lack of participants and suitable power amplifiers. When the amplifiers become available, there may be many more 3-cm EME contacts.

300 GHz and up

As most SHFers know, all frequencies above 300 GHz are open for Amateur Radio. "And then there was light" is a better explanation of many of these frequencies, because some of this spectrum covers the "visible light" range.

When Amateurs first obtained this frequency spectrum, some were quick to respond. They submitted contest contacts when the only communication involved was two people sending code to each other with flashlights. But these early contacts may not have been possible over the minimum 1 mile unless telescopes were used, and that really wasn't what was intended for contest contacts!

As a result, the ARRL modified the contest rules to require that all contest contacts in this frequency spectrum be made between licensed Amateurs using coherent radiation on transmission (eg., laser) and employing at least one stage of electronic detection on receive. Furthermore, in July 1988 the ARRL announced that effective September 1, 1988, there would be a separate VUCC Award for anyone submitting proof of contacts with five grid squares fitting the above mentioned definition.

"VHF/UHF World" has recognized such contacts since the first North

American DX Record table was published in July 1985.⁵ Until recently, only two contacts had been reported. The record was 15 miles on 474 THz. But I recently received a contact report at 678 THz! The contact was made between Dave Chase, KY7B/7, operating from Mt. Lemmon, Arizona (DM42OK) and Terry Wilkinson, WA7LYI/7, on Mt. Graham, Arizona (DM52BQ) at a distance of 56.7 miles (91.25 km).

All the equipment used for this contact was homebrew. It included surplus lasers, a micrometer positioning system, and a "muffin fan" modulator! The signals were MCW at a power level of 24-48 milliwatts.

The receiver used a Fresnel lens, photo multiplier tube, and an audio amplifier. **Photos D, E, and F** show parts of the system. I'm sure we'll be hearing more about their equipment shortly.

Interestingly enough, the biggest problem Dave and Terry encountered in making this contact was "finding" each other. It took three hours. At 56.7 miles, the beam width of the transmitted signal was only 50 feet! They already have plans to break their own record.

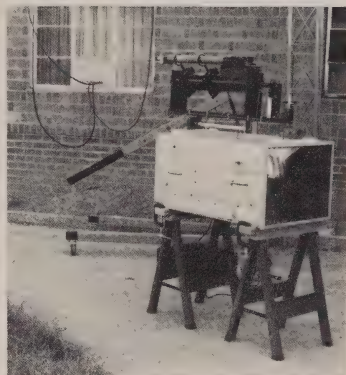
For now, I'll show both long DX contacts made above 300 GHz since they were made in different portions of the visible spectrum. Should the records in this spectrum be subdivided? Perhaps one of you can come up with a more equitable way to list these records. I'd appreciate any suggestions.

Last-minute update

It happened again! Another new record came in just as I was finishing this column. The record is on 33 cm (903 MHz).

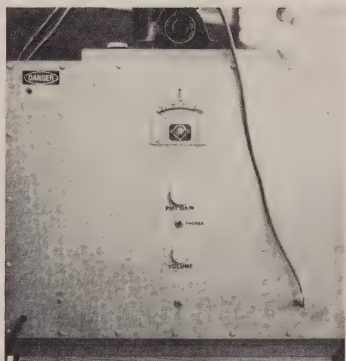
On September 28, 1988, there was excellent tropo propagation between New Jersey and Georgia on 2 meters and 70 cm. At 0413 UTC, Roger Amidon, K2SMN, near Princeton, New Jersey (FN20EJ) completed a CW contact on 903.1 MHz with Steve Adams, WS4F, Cornelia, Georgia

PHOTO D



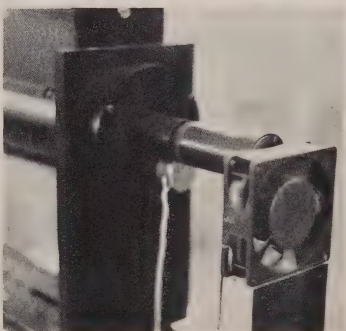
An overall view of the receiver (the engine hoist is not part of the receiver!) used to set the new 678-THz DX record.

PHOTO E



A closeup of the receiver.

PHOTO F



The 1-kHz modulator, a muffin fan!

TABLE 1

North American VHF and above claimed DX records. (Revised 88-10-27)

Frequency	Record Holders	Date	Mode	DX Miles (km)
50 MHz	See note 4.			
EME	WA4NJP(EM84DG)-ZL28GJ(RF70DX)	88-09-08	CW	8258 (13288)
144 MHz				
Aurora	KA1ZE(FN31TU)-WA0TKJ/WB0DRL(EM18CT)	86-02-08	CW	1347 (2167)
EME	VE1UT(FN63XV)-VK5MC(QF02EJ)	84-04-07	CW	10,985 (17676)
FAI	W5HUQ/4(EM90GC)-W5UN(DM82WA)	83-07-25	CW	1228 (1976)
MS	K5UR(EM35WA)-K4EK(GFK68VG)	85-12-13	SSB	1960 (3153)
Spor. E	WA4CQG(EM72FO)-W7YQZ(CN87VR)	88-06-06	SSB	2172 (3495)
TE	KP4EOR(FK78AJ)-LU5DJZ(GF11LU)	78-02-12	SSB	3933 (6328)
Tropo OL	K1RJH(FN31XH)-K5VXZ(EM12QW)	68-10-08	CW	1468 (2362)
Tropo OW	KH6GRU(BL01XH)-WA6JRA(DM13BT)	73-07-29	CW	2586 (4161)
220 MHz				
Aurora	W3IY/4(FM19HA)-WB5LUA(EM13QC)	82-07-14	CW	1145 (1842)
EME	K1WHS(FM43MK)-KH6BFZ(BL11CJ)	83-11-17	CW	5058 (8139)
MS	W1JR(FN42HN)-K0ALL(EN16OU)	88-08-13	SSB	1274 (2057)
Spor. E	K5UGM(EM12MS)-W5HUQ/4(EM90GC)	87-06-14	CW/SSB	932 (1499)
TE	KP4EOR(FK78AJ)-LU7DJZ(GF05RJ)	83-03-09	CW/SSB	3670 (5906)
Tropo OL	K1WHS(FM43MK)-K5UR(EM35WA)	88-09-09	CW	1267 (2039)
Tropo OW	KH6UK(BL11AQ)-W6NLZ(DM03TS)	59-06-22	CW	2539 (4086)
432 MHz				
Aurora	W3PI(FM19PD)-WB5LUA(EM13QC)	86-02-08	CW	1182 (1901)
EME	K2UYH(FN20QG)-VK6ZT(QF78VB)	83-01-29	CW	11567 (18612)
MS	W2AZL(FN20VI)-W0LER(EN35IE)	72-08-12	CW	1021 (1642)
Tropo OL	WB3CZG(FN21AX)-WA5VJB(EM12LQ)	86-11-29	SSB	1318 (2121)
Tropo OW	KD6R(DM13NI)-KH61AA/P(BK29GO)	80-07-28	CW	2550 (4103)
903 MHz				
EME	K5JL(EM15DQ)-WB5LUA(EM13QC)	88-02-07	CW	187 (301)
Tropo OL	K2SMN(FN20EJ)-WS4F(EM84FM)	88-09-28	CW	628 (1011)
1296 MHz				
EME	K2UYH(FN20QG)-VK5MC(QF02EJ)	81-12-06	CW	10562 (16995)
Tropo OL	WB3CZG(FN21AX)-KD5RO(EM13PA)	86-11-29	CW	1287 (2070)
Tropo OW	KH6HME(BK29GO)-WB6NMT/6(DM12KU)	86-08-13	SSB	2528 (4068)
2304 MHz				
EME	W3IWI/8(FM08CK)-ZL2AQE(RE78JS)	87-10-18	CW	8658 (13931)
Tropo OL	KD5RO(EM13PA)-WB7YQ(EN82BE)	86-11-29	CW	940 (1513)
3456 MHz				
EME	W7CNK/5(EM15FI)-K0KE/0(DM79NO)	87-04-12	CW	498 (802)
Tropo OL	WB5AFY(EM04ID)-KX00/0(DM78KU)	88-08-07	CW	455.5 (733)
5760 MHz				
EME	WA5TNY(EM12KV)-W7CNK/5(EM15FI)	87-04-24	CW	174 (279)
Tropo OL	N5JJZ/5(EM26CB)-WA5CW/5(DM86LR)	88-07-10	SSB	404 (650)
10.368 GHz				
EME	WA5VJB(EM12LQ)-WA7CJO(DM33XL)	88-08-27	CW	868 (1397)
Tropo OL	WB7ABP/P(CN81QB)-WB0HLC/6(DM04MS)	88-08-06	CW/SSB	479 (770)
Tropo OW	NN6W/6(CM94XM)-XE2GFH(DL27VL)	88-09-11	MCW	595 (958)
24.192 GHz				
LOS	WA3RMX/7(CN93QI)-WB7UNU/7(CN95DH)	86-08-23	SSB	116 (186)
47.040 GHz				
LOS	WA3RMX/7(CN82VW)-K7AUO/7(CN82PB)	88-08-06	CW/SSB	65.3 (105)
76-149 GHz	None reported.			
300 GHz and above	See note 5.			
474 THz				
LOS	K6MEP/6(DM04IO)-WA6EJO/6(DM04KT)	79-06-09	Laser	15 (24)
678 THz				
LOS	KY7B/7(DM42OK)-WA7LY1/7(DM52BQ)	88-06-12	Laser	56.7 (91.2)

Note 1. The records are listed alphabetically by mode. Tropo OL is over land. Tropo OW is over water (at least 75 percent of the path).

Note 2. The information within the brackets () following the callsign is the grid square locator.

Note 3. Distances have been calculated assuming a spherical earth model using the actual latitude and longitude rather than using the less accurate grid square centers model.

Note 4. Six-meter records, excepting EME, were left off as the primary propagation mode is often hard to distinguish. Long-path QSOs exceeding approximately 12430 miles (20000 km) have been reported during solar cycles 19, 21, and 22.

Note 5. There have been very few reports of contacts in the wide open frequency allocation above 300 GHz. Therefore, at least for the time being, we will list those records that show considerable distance at widely different frequencies.

Choose Kantronics™

the Leader in RF Data Communications.

"Great unit and Super Great Technical Service!!!"

— Bruce Claggett - KB4ZAX

"Have always heard good things about Kantronics. Thought I'd try you out. Like it alot so far!"

— Eric J. Marang - WD8KNL

Kantronics sets the industry standards for service.

"Your support of my KPC-1™ was a major factor in this purchase (of a new KAM™). Thanks, and keep up the Good Work!"

— Art Skufca - KC8XA

"I like (my) KPC-2™ and wanted an all-mode TNC (the KAM™). I like the service I've had from Kantronics."

— Scott Thomas - N6LGB

"I've been very happy with your product; both quality and support I've received."

— Oscar Fick, Jr. - W1MBR

Kantronics has the features others are still "working on."

"Good Unit. I hope Kantronics keeps their software updated as they've done in the past. I like that."

— Bill Gutschmidt - N8ICT

"Please express my appreciation to your co-workers for the wonderful, new toy you've made for me!"

— Myron A. Calhoun - WØPBV

A reputation for excellent technology.

"I received the KAM™ ...as a present...however, I would like to avail of its warranty, although it seems remote that I would ever need to have it repaired within its warranty period considering the excellent and unquestionable quality control your company has over its products."

— Monino S. Duque - DU1BJD

"I hooked it up, and it works fine - thanks for a nice product."

— J. D. Wileman - KA5YJN

✓ 116

Kantronics
RF Data Communications Specialists

1202 E. 23 Street Lawrence, Kansas 66046
(913) 842-7745



TABLE 2

Worldwide claimed VHF/UHF/SHF terrestrial DX records. (Revised 88-10-27)

Frequency	Record Holders	Date	Mode	Miles (km)
50 MHz	Note 3			
70 MHz	GW4ASR/P(I082JG)-5B4CY (KM64MR)	81-06-07	Es	2153 (3465)
144 MHz	I4EAT(JN54VG)-ZS3B(JG73OI)	79-03-30	TE	4884 (7860)
220 MHz	KP4EOR(FK68XM)-LU7DJZ(GF05RJ)	83-03-09	TE	3670 (5906)
432 MHz	KD6R(DM13NI)-KH6IAA/P(BK29GO)	80-07-28	Duct	2550 (4103)
903 MHz	K2SMN(FN20EJ)-WS4F(EM84FM)	88-09-28	Tropo	628 (1011)
1296 MHz	KH6HME(BK29GO)-WB6NMT(DM12KU)	86-08-13	Duct	2528 (4068)
2304 MHz	VK5QR(PF95HD)-VK6WG/P(OF85WA)	78-02-17	Duct	1170 (1883)
3456 MHz	VK5QR(PF95HD)-VK6WG(OF85WA)	86-01-25	Duct	1171 (1885)
5760 MHz	G3ZEZ(JO01MS)-SM6HYG(JO58RG)	83-07-12	Duct	610 (981)
10.3 GHz	I0SNY/EA9(IM75IV)-I0YLI/IE9(JM68NR)	83-07-08	Duct	1032 (1660)
24 GHz	I0SNY/IC8(JN60WR)-I8YZO/8(JM78WE)	84-08-11	LOS	206 (331)
47 GHz	WA3RMX/7(CN82VW)-K7AUO/7(CN82PB)	88-08-06	LOS	65.3 (105)
75 GHz	HB9AGE/P(JN37RD)-HB9MIN/P(JN37RD)	85-12-30	LOS	0.3 (0.5)
474 THz	K6MEP(DM04IO)-WA6EJO(DM04KT)	79-06-09	LOS	15 (24)
678 THz	KY7B/7(DM42OK)-WA7LYI/7(DM52BQ)	88-06-12	LOS	56.7 (91.2)

Notes:

1. The information within the brackets () after the callsign is the grid square locator.
2. Distances have been calculated assuming a spherical earth model. The actual latitude and longitude are used rather than the less accurate grid square centers model.
3. Six meters has been left blank on this listing because long-path QSOs (those exceeding approximately 12430 miles or 20000 km) have been reported during solar cycles 19, 21, and 22.

(EM84EM), over a distance of 628 miles (1011 km). This extends the previous record by about 5 miles and shows why it's good to know exact station coordinates.

Roger was running 80 watts to a quad array of 23-element Tonna Yagis. Steve was running 130 watts to a single 33-element loop Yagi. Both stations had system noise figures below 1.0 dB. Signals were several dB out of the noise.

Latest DX record tables

Here are the latest record tables; they've all been updated. Note changes in grid squares since the last time these tables were published.

Many locations have been more accurately determined.

I made a few typographical errors in the previous tables. I hope they didn't cause any grief. If you find mistakes or have questions on the data shown in any of the tables, please let me know. After all, this is a process of evolution and you can't challenge a record that has incorrect data.

Table 1 shows the latest North American DX records, table 2 the latest worldwide DX records, and table 3 the latest EME records — including the first-ever 3-cm contact.

Region 1 DX Records

Up until now, the tables published

in "VHF/UHF World" have only recognized North America and worldwide DX records. There are other long distance contacts that, while not records on these tables, are still rather interesting and impressive.

Some of these contacts include the records made in Region 1, which includes Europe, Africa, and the Soviet Republics. These records reflect the SOA in other parts of the world and I think they're important. Also, several VHF and above devotees have been questioning me on what our peers outside North America are doing.

For several years Region 1 DX records have been carefully

ANTENNAS

KLM

World Class Antennas for the Serious Amateur!
KT34A.....\$395.00 KT34XA.....\$585.00
Monobanders: 80-10 Meters!
High Performance VHF & UHF antennas.

hy-gain

Tribanders

TH7DXS

Explorer-14

TH5Mk2S

TH3JrS

Monobanders

204 BAS

203 BAS

205 BAS

155 BAS

153 BAS

105 BAS

103 BAS

66 BAS

VHF, OSCAR & VERTICAL ANTENNAS!

NEW! High Performance 144 & 432 MHz Antennas.
Call For Prices!

cuscraft

WINTER SPECIAL! The "A3S."
The Popular A3 with Stainless Steel
Hardware at a Special RFE Price.

A4S.....

A744 Add on Kit.....

A3SK & A4SK Stainless Kits.....

AV3 & AV5 Verticals.....

AP8 & APR 18.....

40-2CD 2-el, 40 Mtr. Beam.....

Monobanders For 10, 15, & 20 in Stock!

617-6B 6 Mtr BOOMER.....

A50-5, A50-6.....

A147-11, A147-20T.....

215WB & 230WB 15 & 30 el 2 Mtr.....

AOP-1 Satellite System.....

4218XL & 3219 for 144-146 MHz.....

220B, 424B BOOMERS.....

Large Inventory Of Other Antennas & Accessories

BUTTERNUT

HF6V.....

FMK II Kit.....

TBR-180S Coll.....

HF2V.....

STR II Kit.....

SC-3000 Antenna.....

HF5B.....

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

ALPHA DELTA

DX-A.....\$46.95

DX-DD.....\$4.95

DX-KT.....\$27.50

NEW! DX-CC All band dipole.....\$79.95

Full line Alpha Delta switches & Transi-traps!

HUBER

6BTU.....\$134.95

5BTU.....\$124.95

G6-144B.....\$86.95

G7-144.....\$119.95

G7-220.....\$114.95

Complete HF Mobile Systems. CALL!

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

CALL

TEN-TEC



MODEL 561 CORSAIR II

OTHER TEN-TEC PRODUCTS:

Model 585 Paragon

Model 425 Titan Linear Amplifier

Model 229A 2KW Antenna Tuner

Model 2510 Satellite Station

Full line of filters, power supplies, mobile
antennas, and accessories in stock.

YAESU

FT-757 GXII

All Mode
Transceiver



FT-727

Dual Band
Handheld



FT-212 RH

2 Meter Mobile

AMPLIFIERS & TUNERS



NYE-VIKING

MB-V-A

MAGNUS SOLID STATE HF LINEAR AMPS

MFJ

KEYERS

ACCESSORIES



SPECIAL!

989B Tuner \$275.00

ASTRON POWER SUPPLIES

Rack mount and speaker models in stock!

RS-4A.....\$37.95 RS-7A.....\$49.95 RS-12A.....\$69.95

RS-20A.....\$88.95 RS-35A.....\$135.95 RS-50A.....\$193.95

RS-20M.....\$106.95 RS-35M.....\$153.95 RS-50M.....\$216.95

VS-20M.....\$124.95 VS-35M.....\$171.95 VS-50M.....\$232.95

SSB ELECTRONIC & MICROWAVE
MODULES TRANSVERTERS, PREAMPS,
& ACCESSORIES. CALL!

TOWERS

HY-GAIN

Crank-up, self-supporting, galvanized steel
towers. SS rated at 9 ft; HD at 16 ft.

HG-37SS

HG-54HD

CALL FOR PRICES

HG-52SS

HG-70HD

ROHN

Self-supporting: Ratings: HDBX at 18 ft,
HBX at 10 ft, BX at 6 ft.

HBX 40.....

HDBX 40.....

HBX 48.....

HDBX 48.....

HBX 56.....

BX 64.....

Galvanized steel with base and rotor plate.
Today's best buy. Freight additional but you save
with our volume shipper's discount!

GUYED TOWER SECTIONS:

25G, 45G, 55G Sections and All Accessories in
Stock. Call for Current Prices.

FOLD-OVER TOWERS:

FK2548.....

FK2558.....

FK2568.....

FK4544.....

FK4554.....

FK4564.....

Prices 10% higher in western states.

ROOF TOWERS & CLIMBING BELTS.....Call!

TOWER HARDWARE

Guywire: 3/16HS / 1/4 EHS, per ft.....\$0.15/0.18

CCM Cable Clamps: 3/16 / 1/4.....\$0.39/0.49

Turnbuckles: 3/8" E & E/E & J.....\$6.95/7.95

1/4" E & E/E & J.....\$12.95/13.95

Thimbles: 1/4" (3/16 & 1/4" cable).....\$0.39

Earth Anchor: 4 ft. Screw-In.....\$13.95

Preformed "Big Grip": 3/16 & 1/4.....\$2.49/2.99

Guy Insulators: 500 D/502.....\$1.69/2.99

PHILLYSTRAN GUY SYSTEMS

HPTG-2100/4000/6700 Cable.....\$0.30/50/70

Cable Ends: 9901/LD/9902LD.....\$8.95/10.95

Socketfast Potting Compd.....\$15.95

WIRE & CABLE

BELDEN COAX

9913 low loss.....\$0.47/ft RG-8X(9258).....\$0.22

RG-213/U(8267).....\$0.48 RG-11A/U(8261).....\$0.43

RG-8/U(8237).....\$0.38 RG-58A/U(8259).....\$0.17

RG-8/U(8214).....\$0.42 RG-59/U(8241).....\$0.18

RG-214/U(8268)\$2.30/ft.

450 Ohm Ladder Line.....\$0.10

COPPERWELD ANTENNA WIRE

Solid: 12 ga.....\$0.12 14 ga.....\$0.09

Stranded 14 ga.....\$0.10

Plus Wide Selection Baluns, Insulators, Accessories

ROTOR CABLE

Std(6-22, 2-18).....\$0.21 Hvy(6-18, 2-16).....\$0.38

Others in stock.

AMPHENOL CONNECTORS

PL-259: std/silver/teflon.....\$0.89/1.25/1.45

UG-21B (8261) Type N Male.....\$2.95

T's, angles, adaptors, jacks, & BNC in stock!

COAX AVAILABLE IN PRECUT LENGTHS WITH
CONNECTORS ATTACHED.

• • COAXIAL SWITCHES • •

ANDREW HELIX & CONNECTORS

1/4" LDF4-50A.....CALL 7/8" LDF5-50A.....CALL

ALINCO • AMERITRON • AMP SUPPLY • ANTENNA SPECIALISTS • ASTATIC • BENCHER • B & W • CREATE • DAIWA
• KANTRONICS • LARSEN • MFJ • MOSLEY • NYE-VIKING • PALOMAR • SANTEC • SHURE • TONNA • WELZ & MORE

ORDER ONLY:

1-800-233-2482

SHIPPING, INFO. TECHNICAL, MN & DX.

218-765-3254

TELEX:

4933032 RFE UI

FAX:

218-765-3308

rf enterprises

HCR Box 43

Merrifield, MN 56465

(Located at Jcn. Co. 3 & 19)

Prices subject to
change without notice.
Minnesota residents
add 6% tax.
Shipping additional
except as noted.

RETURNS REQUIRE AUTHORIZATION &
SUBJECT TO 15% RESTOCKING CHARGE

here is the next generation Repeater
2 meters - 220 - 440

MARK 4CR

The **only** repeaters and controllers
with REAL SPEECH!

No other repeaters or controllers match Mark 4 in capability and features. That's why Mark 4 is the performance leader at amateur and commercial repeater sites around the world. Only Mark 4 gives you Message Master™ real speech • voice readout of received signal strength, deviation, and frequency error • 4-channel receiver voting • clock time announcements and function control • 7-helical filter receiver • extensive phone patch functions. Unlike others, Mark 4 even includes power supply and a handsome cabinet.

Call or write for specifications on the repeater, controller, and receiver winners.



MICRO CONTROL SPECIALTIES

Division of Kendecom Inc.

23 Elm Park, Groveland, MA 01834 (508) 372-3442



TELEX 4932256 Kendecom

FAX 508-373-7304

NEMAL ELECTRONICS

*Complete Cable Assembly facilities MIL-STD-45208

*Commercial Accounts welcome- Quantity pricing • Same day shipping most orders

*Factory authorized distributor for Alpha, Amphenol, Belden, Kings, Times Fiber

Call NEMAL for computer cable, CATV cable, Flat cable, semi-rigid cable, telephone cable, crimping tools, D-sub connectors, heat shrink, cable ties, high voltage connectors.

HARDLINE 50 OHM

FXA12 1/2" Aluminum Black Jacket.....	.89/ft
FL012 1/2" Cableweave corr. copper blk jkt	1.69/ft
FL078 7/8" Cableweave corr. copper blk jkt	3.92/ft
NM12CC N conn 1/2" corr copper m/f	25.00
NM18CC N conn 7/8" corr copper m/f	54.00

COAXIAL CABLES (per ft)

1180 BELDEN 9913 very low loss .....	.52
1102 RG8/U 95% shield low loss foam 11ga.....	.36
1110 RG8X 95% shield (mini B) .....	.17
1130 RG213/U 95% shield mil spec NCV jkt.....	.39
1140 RG214/U dbl silver shld mil spec.....	1.85
1705 RG142B/U dbl silver shld, teflon ins	1.50
1310 RG217/U 50 ohm 5000 watt dbl shld .....	.98
1450 RG174/U 50 ohm .100" od mil spec .....	.14

ROTOR CABLE-8 CONDUCTOR

8C1822 2-18ga and 6-22ga .....	.21
8C1820 2-18ga and 6-20ga .....	.39

CONNECTORS-MADE IN USA

NE720 Type N plug for Belden 9913	\$3.95
NE723 Type N jack for Belden 9913.....	4.95
PL259 standard UHF plug for RG8,213.....	.65
PL259AM Amphenol PL259 .....	.89
PL259TS PL259 teflon ins/silver plated.....	1.59
PL259AM Amphenol female-female (barrel).....	1.65
UG175/UG176 reducer for RG58/59 (specify).....	.22
UG21DS N plug for RG8,213,214 Silver.....	3.35
UG83B N jack to PL259 adapter, teflon	6.50
UG146A SO239 to N plug adapter, teflon	6.50
UG255 SO239 to BNC plug adapter, Amphenol.....	3.29
SO239AM UHF chassis mt receptacle, Amphenol.....	.89

GROUND STRAP-GROUND WIRE (per ft.)

GS38 3/8" tinned copper braid .....	.40
GS12 1/2" tinned copper braid .....	.50
GS200 1-1/2" heavy tinned copper braid	2.00
HW06 6ga Insulated stranded wire .....	.35
AW14 14ga stranded Antenna wire CCS .....	.14

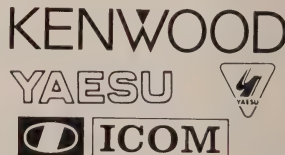
Prices do not include shipping, \$3 minimum, Visa/Mastercard \$30 min, COD add \$3.00

Call or write for complete price list. NEMAL's new 36 page CABLE AND CONNECTOR SELECTION GUIDE is available at no charge with orders of \$50 or more, or at a cost of \$4 with credit against next qualifying order.

NEMAL ELECTRONICS, INC. 12240 NE 14th Ave. N. Miami, FL 33161
(305) 893-3924 Telex 6975377 24hr FAX (305)895-8178

K COMM., INC. THE HAM STORE

Stocking all major lines. San Antonio's
Ham Store. Great Prices—Great Service.
Factory authorized sales and service.
Hours: M-F 10-6, SAT 9-3



5707A Mobud
San Antonio, TX 78238
800-344-3144
Orders Only



TABLE 3

Worldwide claimed VHF/UHF/SHF EME DX records. (Revised 88-10-27)

Frequency	Record Holders	Date	Mode	Miles (km)
50 MHz	WA4NJP(EM84DG)-ZL2BGJ(RF70DX)	88-09-08	CW	8258 (13288)
144 MHz	K6MYC/KH6(BK29AO)-ZS6ALE(KG43RC)	83-02-18	CW	12091 (19455)
220 MHz	K1WHS(FN43MK)-KH6BFZ(BL11CJ)	83-11-17	CW	5058 (8139)
432 MHz	F9FT(JO29AG)-ZL3AAD(RE66GR)	80-04-18	CW	11679 (18793)
902 MHz	K5JL(EM15DQ)-WB5LUA(EM13QC)	88-02-07	CW	187 (301)
1296 MHz	PA0SSB(JO11WI)-ZL3AAD(RE66GR)	83-06-13	CW	11595 (18657)
2304 MHz	W3IWI/8(FM08CK)-ZL2AQE(RE78JS)	87-10-18	CW	8658 (13931)
3456 MHz	W7CNK/5(EM15FI)-K0KE(DM79NO)	87-04-06	CW	498 (802)
5760 MHz	WA5TNY(EM12KV)-W7CNK/5(EM15FI)	87-04-24	CW	174 (279)
10368 MHz	WA5VJB(EM12LQ)-WA7CJO(DM33XL)	88-08-27	CW	868 (1397)
24000 MHz and above	None reported.			

Notes:

1. The information within the brackets () following the callsigns is the grid square locator.

2. The distances shown have been calculated assuming a spherical earth model. The actual latitudes and longitude are used rather than the less accurate grid square centers model.

documented by Folke Rosvall, SM5AGM, who updates them annually. Most, but not all, of the DX records shown in **table 4** are from the list published by Folke. However, I reserve the right to update them myself. I plan to include some impressive tropo and aurora claims that don't appear in Folke's table, or are very recent. Some Region 1 DX records, like FAI, aren't included or available, but I hope they will be in the near future.

I must make one final point about **table 4**. Folke determined most of the distances on this table using the new "ellipsoidal" earth model for distance determination. In some cases, interpretation may be necessary when comparing these records with those shown in **tables 1, 2, and 3**. What are your impressions of **table 4**? Do you find it valuable?

Summary

January and February's columns are dedicated to those who have tried as

well as those who have succeeded in setting new VHF and above DX records — an important aspect of Amateur Radio.

In a sense these columns have been like an anatomy of how the records are achieved and how they improve the SOA. I hope that this background material and the challenges I've described will encourage you to try to improve the SOA and/or make an attempt at one of the many records available to those who operate above 50 MHz.

In the meantime, please keep me informed of your progress on new record attempts or challenges. Remember to write to me for a "VHF/UHF/SHF Propagation Record Verification Form," or fill out a copy of **table 4** on page 47 of the June 1988 column.³

Acknowledgments

I'd like to thank all who submitted DX record information — especially for January and February's columns. In

particular I'd like to thank (and I hope I don't miss anyone): K1WHS, WA3RMX, WA4NJP, KB4WM, WA5ICW, K5UR, WA5VJB, N6XQ, KY7B, W7YOZ, KX0O, and WB0HLO.

Notes

In last September's column⁶ I listed the addresses of several VHF publications. I've recently been informed that two have changed as follows:

2-Meter EME Bulletin, c/o R.E. Turner, 14826 Daisy Lane, Tampa, Florida 33613.

MidWest VHF/UHF Society, c/o Steve Whitefield, WA3OJX, 400 S. Main Street, Springboro, Ohio 45066. This monthly publication is available for \$6.00 per year.

Important VHF/UHF Events

February 6 *New Moon*
 February 7 *EME perigee*
 February 20 *Total lunar eclipse*
 March 7 *New moon with partial solar eclipse*
 March 8 *EME perigee*
 March 21 ±2 weeks. Optimum time for TE propagation

TABLE 4

IARU Region 1 VHF and above claimed DX records. (Revised 88-10-27)

Frequency	Record Holders	Date	Mode	DX miles (km)
50 MHz				
F2	EL2AV(IJ46)-H44PT(RI00OA)	82-04-04	SSB	11764 (18932)
70 MHz				
Aurora	G3SHK(1090DX)-GM3WOJ/P(1089KB)	82-08-11	CW	562 (904)
MS	GJ3YHU(1N89XI)-GM3WOJ/P(1089KB)	82-08-12	?	673 (1083)
Spor. E	GW4ASR/P(1082JG)-5B4CY(KM64MR)	81-06-07	?	2153 (3465)
Tropo	G4FRE/P(1070PP)-GM4ZUK/A(1087WB)	86-09-21	SSB	456 (734)
144 MHz				
Aurora	G4VBG(1094FW)-UA32FI(KO76WT)	86-02-07	CW	1373 (2209)
EME	K6MYC/KH6(BK29AO)-ZS6ALE(KG46RC)	84-02-18	CW	12091 (19455)
MS	GW4CQT(1081LP)-UW6MA(KN97VE)	77-08-12	CW	1927 (3101)
Spor. E	EA8XS(IL28GA)-HG0HO(KN07RU)	83-07-16	SSB	2402 (3865)
TE	I4EAT(JN54VG)-ZS3B(JG73OI)	79-03-30	CW	4884 (7860)
Tropo	EA8BEX(IL27GX)-G4KIS(1064VR)	88-07-15	CW/SSB	1904 (3064)
432 MHz				
Aurora	PA0RDY(JO22KJ)-RA3LE(KO64AR)	86-02-08	CW	1123 (1807)
EME	F9FT(JN29AG)-ZL3AAD(RE66GR)	80-04-18	CW	11749 (18907)
MS	EI2VAH(1043XW)-SK6AB(JO57XQ)	80-08-12	CW	891 (1434)
Tropo	EA8XS(IL28GA)-GW8VHI(1081CM)	84-07-05	SSB	1731 (2786)
1296 MHz				
EME	PA0SSB(JO11WI)-ZL3AAD(RE66GR)	83-06-13	CW/SSB	11665 (18772)
Tropo	EA8XS(IL26GA)-G6LEU(1070ME)	85-06-29	SSB	1626 (2617)
2304 MHz				
EME	PA0SSB(JO11WI)-W6YFK(CM87WJ)	81-04-05	CW/SSB	5506 (8860)
Tropo	EA7BVD/P(1M78JD)-EA8XS/P(IL27GW)	84-07-08	SSB	920 (1481)
3456 MHz				
Tropo	G3LQR(JO02QF)-SM6HYG(JO58RG)	83-07-11	CW	576 (927)
5760 MHz				
Tropo	G3ZEZ(JO01MS)-SM6HYG(JO58RG)	83-07-12	CW/SSB	610 (981)
10.368 GHz				
Tropo	I0SNY/EA9(IM751V)-I0YLI/IE9(JM68NR)	83-07-08	FM	1032 (1660)
24 GHz				
Tropo	I0SNY/IC8(JN60WR)-I8YZO/8(JM78WE)	84-08-11	FM	206 (331)
47 GHz				
Tropo	HB9AGE/P(JN36FS)-HB9MIN/P(JN36SX)	87-06-06	?	53 (86)
75 GHz				
LOS	HB9AGE/P(JN37RD)-HB9MIN/P(JN37RD)	87-06-06	FM	0.3 (0.5)

Notes:

1. The records are listed alphabetically by mode.
2. The information within the brackets () following the callsign is the grid square locator.
3. The distances are calculated using an ellipsoidal earth model.

References

1. Joe Reisert, W1JR, "VHF/UHF World-DX Records on 50 MHz and Above-Part 1," *Ham Radio*, January 1989, page 48.
2. Joe Reisert, W1JR, "VHF/UHF World-Optimized 2- and 6-Meter Yagis," *Ham Radio*, May 1987, page 92.

3. Joe Reisert, W1JR, "VHF/UHF World-Propagation Update-Part 2," *Ham Radio*, June 1988, page 39.
4. Joe Reisert, W1JR, "VHF/UHF World-Microwave and Millimeter-wave Propagation, Part 2," *Ham Radio*, August 1986, page 69.

5. Joe Reisert, W1JR, "VHF/UHF World-Propagation Update," *Ham Radio*, July 1985, page 86.
6. Joe Reisert, W1JR, "VHF/UHF World-More Loose Ends," *Ham Radio*, September 1988, page 53.

Article E

HAM RADIO

Takes the fear out of full power antenna tuners,
and the guesswork out of PEP measurement
with these two MUST SEE PRODUCTS!!

CHECK THE FEATURES:

- **PI Network.** Low Pass PI Network tuning 1.8-30 MHz. Heavy duty silver plated continuously variable inductor with 25:1 vernier dial. 7000 volt variable capacitor and 10,000v switch selected fixed capacitors on output side. Tunes 40-2000 ohms loads. Good Harmonic suppression!
- **Automatic SWR.** Hands free metering of SWR. No reset or calibration needed. Separate power meter—300 or 3000 w f.s. automatically switched. Easy to read 2.5" recessed and back-lighted taut band meters.
- **Antenna Switch.** PUSH-BUTTON antenna switching to (4) antennas (2 coax, single wire and twin lead). Coax bypassed on first coax output. We designed this switch to take the power. Rated at 10KV and 20 amps.
- **3 KW Balun.** Trifler wound triple core torroid gives balanced output to twin feeder from 200 to 1000 ohms and unbalanced output down to 20 ohms.
- **Maximum Power Transfer.** Match your transmitter output impedance to almost any antenna system for maximum power transfer. Amplifiers only run at their designed Q when properly matched.
- **Model Options.** MB-IV-A1 includes all MB-V-A features less antenna switch and balun. MB-IV-A2 is identical to MB-IV-A1 with the addition of a triple core balun.
 - 1.8 MHz will not tune on some antennas.
- **(3) Modes** — Peak Average and Peak and Hold with a unique non-drift Sample & Hold Analog memory circuit.
- **(2) Ranges** — Automatically switched power scales to 5 KW.
- **Fully Automatic SWR** — Full time meter displays ratios directly without drift
- **Built-in ALO** — Protect your amplifier tube investment with this fast acting lockout.
- **Remote Couplers** — Six feet remotes the interchangeable calibrated couplers.
- **True RMS Conversion** — H.F. couplers use forward biased full wave detection.
- **Rugged Construction** — Heavy gauge aluminum construction. Top quality glass epoxy PCB. This meter is built to last.
- **Accuracy** — Guaranteed to $\pm 5\%$ F.S.
- **Warranty** — TWO FULL YEARS.
- **Added Features** — Switchable reverse power all mode metering — Full status LED Display — Adjustable ALO is switchable SWR/REFL power — Heavy duty Nicad batteries charged by the applied RF for the field and a charger is supplied for fast charging and backlighting of the taut band meters for the ham shack.

OTHER NYE VIKING PRODUCTS

Phone Patches — Electronic and Memory Keyers — Squeeze Keys — Straight Keys — Code Practice Sets — SWR Wattmeter for the blind — Low Pass Filters — All Band Antennas and more . . .

ASK FOR A FREE FULL LINE CATALOG.

TO ORDER, CALL YOUR FAVORITE DEALER

Amateur Electronic Supply
Ham Radio Outlet
Henry Radio
Madison Electronics
EGE
R&L Electronics
r f enterprises

Barry Electronics
C-Comm
Ross Distributing
Quement Electronics
LaCue Communications
Ham Station



Wm. M. Nye Co. Inc.
1614 130th Ave. N.E.
Bellevue, WA 98005
TEL: (206) 454-4524
FAX: (206) 453-5704



THE HAM NOTEBOOK

Crank-up tower cable guides

PHOTO A

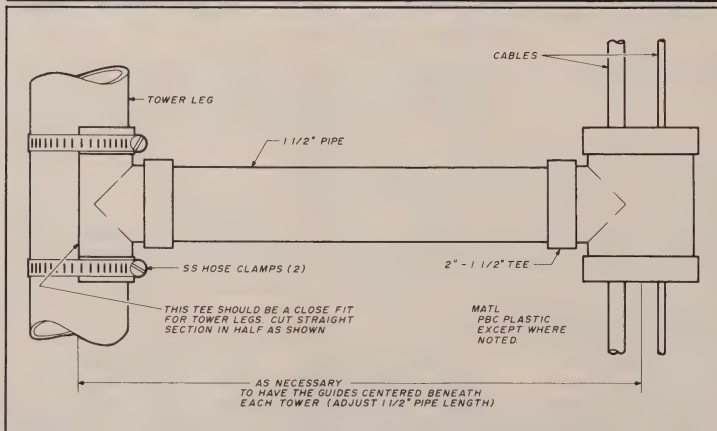


One of the cable guides installed on my tower.

When I set up my new crank-up tower, I installed the cable guides shown in photo A and fig. 1. Phil Malmberg, W4NOO, of Cocoa Beach, Florida designed the guides. He has used them successfully on his 60-foot crank up for years. The guides control the motion of the cables from the rotator and antennas. They prevent excess sway in the wind when the tower is cranked up and help make a neat pile at the foot of the tower when it's cranked down. Use two guides on the bottom tower section and one at the top of each movable section.

George Wilson, W1OLP

FIGURE 1

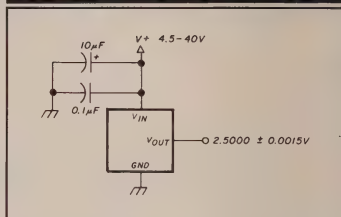


Details for assembling and installing the cable guides.

Simple inexpensive check for voltmeter accuracy

Do you have an old voltmeter that you'd like to check for accuracy or recalibrate? This can present problems if you don't have a standard cell or access to some other sophisticated test gear. Here's a simple inexpensive solution built around a Precision Monolithics REF 43F voltage reference IC.* (see fig. 1)

FIGURE 1



Schematic of a simple, high-accuracy voltage source.

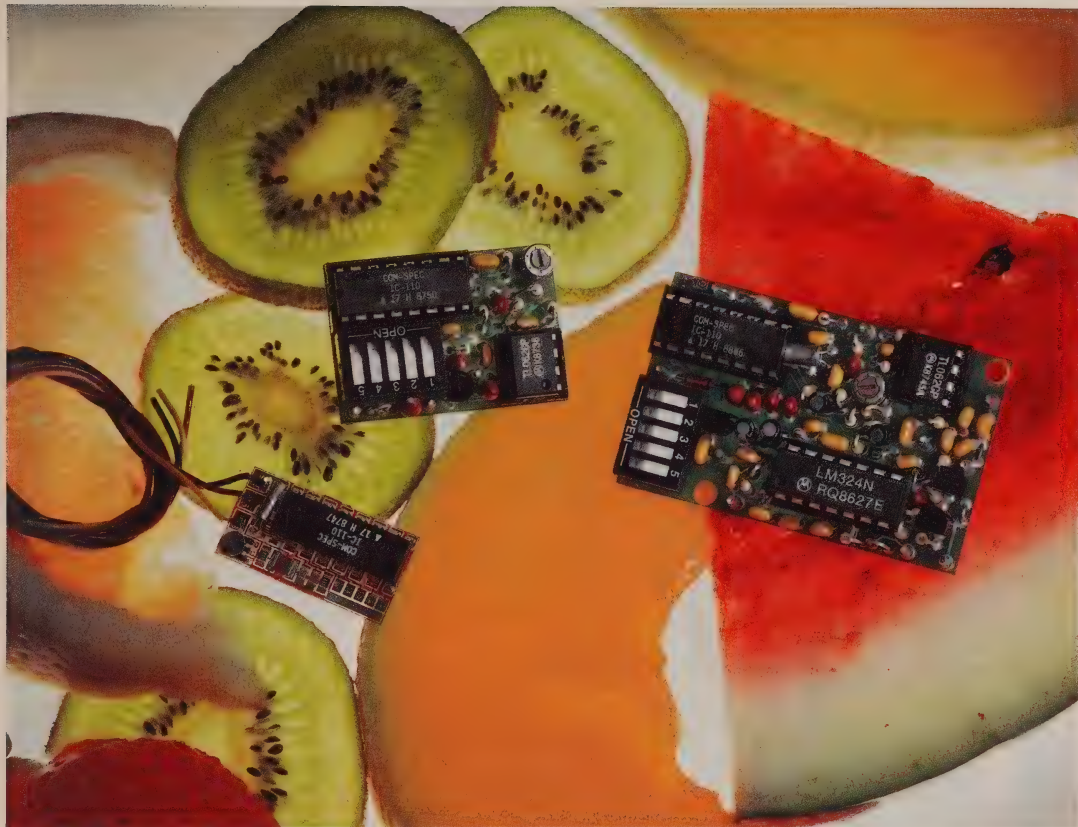
The 43F is guaranteed to have a maximum error of 0.06 percent from its normal 2.50-volt reference point (i.e., between 2.4985 to 2.5015 volts). It will operate with a DC voltage source between +4.5 and +40 volts and supply a minimum of 10 mA into a load. The quiescent supply current at no load is 450 µA, maximum.

These characteristics indicate that the 43F can be run from a battery or power supply source, and that a precision voltage divider can be used to supply an output of less than 2.5 volts.

It's probably a good idea to put the unit in a small box to reduce the thermocouple effects on the leads and to prevent sudden temperature changes.

*The REF 43F is available from: Allied Electronics, 401 E. 8th Street, Fort Worth, Texas 76102. Ed.

Arthur L. Bachelor, M.D.
Article F



Choice Selection.

Now you can have it all! Take all the qualities you've come to depend on in our programmable CTCSS tone equipment: Astonishing Accuracy; Instant Programming; Unequaled Reliability; and add full spectrum tone versatility multi-tone capability without diodes, a reprogrammable memory...It's our new harvest of CTCSS tone equipment.

The choice is yours! If standard CTCSS EIA tones do not suit your taste, select any 32 tones of your liking from 15.0Hz to 255.0Hz. And if you change your mind, no problem; the memory can be changed in your shop with our HHP-1 programmer, or at our factory for free. Your working tone is accessed by a simple DIP switch, so there's no fussing with counters or other test equipment.

Call today toll-free and find out more about this fresh new flexibility in tone signalling, and don't forget to ask about multi-tone switching without cumbersome diode networks or binary switches.

It's all brought to market by the people who introduce the freshest ideas in tone signalling, and of course our customary same day shipping and one year warranty apply.

TS-32P CTCSS ENCODER-DECODER Based on the time proven TS-32, the industry standard for over a decade. The TS-32P gives you the added versatility of a custom, changeable memory base. A low price of \$57.95 makes it an even sweeter deal.

SS-32P ENCODER Based on the equally popular SS-32 encoder. Available for CTCSS, or audible burst tones up to 6550.0Hz. Price is \$28.95.

SS-32SMP SUB-MINIATURE ENCODER Our smallest encoder for handheld applications. Now you can satisfy that customer that needs to access multiple repeater sites with a radio that has precious little space inside. At \$27.95, the price is small too.

HHP-1 HANDHELD PROGRAMMER For programming the 32 memory locations in any of our new programmable products, including our SD-1000 Two-Tone Sequential decoder. The HHP-1 is battery operated for field use, and will program ANY 32 tones from 15.0 to 6550.0Hz in .1Hz. increments. Price is \$199.95.



COMMUNICATIONS SPECIALISTS, INC.

426 West Taft Avenue • Orange, CA 92665-4296

Local (714) 998-3021 • FAX (714) 974-3420 • Entire U.S.A. 1-800-854-0547

**GUARANTEED
QUALITY
AT COMPETITIVE PRICES**



HAM RADIO OUTLET

LARGEST HAM OUTLET IN THE WORLD

7

STORE BUYING POWER

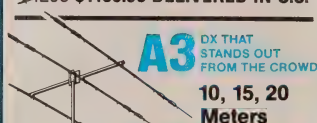


GEOCHRON
GLOBAL
TIME
INDICATOR

SALE

- Detailed illuminated map shows time, time zone, sun position and day of the week at a glance for any place in the world.
- Continuously moving - areas of day and night change as you watch.
- Mounts easily on a wall. Size: 34 1/2" x 22 1/2".

\$1295 \$1159.95 DELIVERED IN U.S.



A3 DX THAT
STANDS OUT
FROM THE CROWD

**10, 15, 20
Meters**

cushcraft

Whether busting pileups, rag chewing or hunting rare DX, the A3 stands out from the crowd with the perfect combination of easy assembly, the right size, rugged durability and great performance.

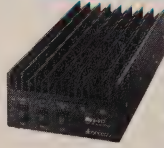
- Boom Length 14 ft., Weight 27 lbs.
- Wind Surface Area 4.36 ft.

REG.
349.95
SALE
259.95

Plus Shipping

SALE

concept



**VHF/UHF
SOLIDSTATE
AMPLIFIERS**

Contemporary design, quality and a 5 year warranty on parts and labor.

6 months on the RF Final transistors.

All amplifiers have GaAsFET receive pre-amps and high SWR shutdown protection.



MA-40
40' TUBULAR TOWER
-\$899 SALE! \$629

MA-550
55' TUBULAR TOWER
-\$1369 SALE! \$999

- Handles 10 sq. ft. at 50 mph
- Pleases neighbors with tubular streamlined look

TX-455

55' FREESTANDING
CRANK-UP

- Handles 18 sq. ft. at 50 mph
- No guying required
- Extra-strength Construction
- Can add raising and motor drive accessories

Shown with optional
MARB rotor base

TOWERS RATED TO EIA SPECIFICATIONS
OTHER MODELS AT GREAT PRICES
IN STOCK FOR QUICK DELIVERY

TEN-TEC



PARAGON 585

- Ten-Tec QSK cw, real FSK and sideband audio
- Select any filter in any mode
- TX 160 through 10 meters • All mode superiority
- RX 100 kHz to 30MHz • A premier HF rig



TITAN 425

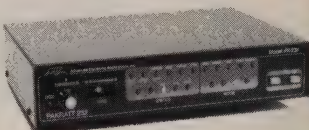
- Pair 3CX800A7 • External Power Supply
- Performance at legal limit
- 3 MS QSK, 1.6 to 22 MHz • Assures "Loaf Along"
- With authorized modification through 29.999 MHz

IN STOCK NOW! FREE SHIPMENT!

AEA

*Advanced
Electronic
Applications*

**PK-232 Multi-mode
Data Controller**



- NEW IBM Fax Screen Display Program Available
- Transmit/Receive on Six Modes
- CW/RTTY/ASCII/AMTOR/Packet/FAX
- IBM and Commodore terminal programs available
- Radio Ports for HF and VHF

In Stock for Quick Delivery

Free Shipment

KENWOOD

TM-721A DUAL BANDER

2MTR/70cm

45w 35w

EXTENDED RECEIVING
RANGE (2 m)



TM-621A DUAL BANDER

2MTR/220MHz

45w 25w

AUTOMATIC OFFSET

**CALL FOR LOW,
LOW PRICE**

**FREE
SHIPMENT**
Most items UPS
surface

All Major Brands in Stock Now!

OUTSIDE
CALIFORNIA

CALL TOLL FREE (800) 854-6046

INSIDE CALIFORNIA CALL STORES DIRECT

Toll free including Hawaii. Phone Hrs: 7:00 am to 5:30 pm Pacific Time, California, Arizona and Georgia customers call or visit nearest store.

California, Arizona and Georgia residents please add sales tax. Prices, specifications, descriptions subject to change without notice.



HAM RADIO OUTLET

LARGEST HAM OUTLET IN THE WORLD

7

STORE BUYING POWER

ICOM IC-761

HF SUPERIOR GRADE
TRANSCIVER

SALE! CALL FOR PRICE

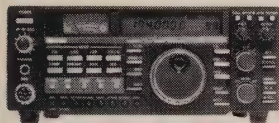
ICOM IC-781

THE ULTIMATE
150 W, ALL BAND
HF TRANSCIVER

GREAT PRICE!

ICOM IC-900
MULTI-BAND
MOBILEYOU CAN OPERATE SIX BANDS
WITH ONE CONTROLLER!
2 MTR 25/45W, 440 MHz 10 MTR, 6 MTR,
220 MHz & 1.2 GHz 10 MEMORIES
**ARE YOU READY FOR
1.2 GHz OPERATION?**

ICOM

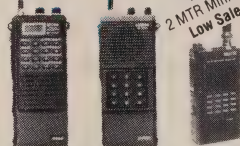
A Models 25W,
H Models 100 WIC-275A/275H, 138-174 MHz
IC-475A/475H, 430-450 MHz

LOW PRICE!

SPECIAL ICOM MONTH PRICING

Feb. 14th Oakland
Feb. 11th Phoenix & San Diego
Feb. 18th Burlingame & Anaheim
Feb. 25th Atlanta & Van NuysSPECIAL IN-STORE AND
WATTS LINE PRICING

ICOM

HAND-HELD
VHF/UHF
IC-2AT
2 MTR Mini Hand-held
Low Sales PriceIC-02AT IC-2AT 2MTR
IC-03AT IC-3AT 220 MHz
IC-04AT IC-4AT 440 MHz

ICOM IC-735

100 W, 100 KHz-30 MHz
Dual VFO Receiver

CALL FOR LOW, LOW PRICE

ICOM IC-R7000

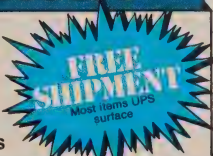
25 MHz-1300 MHz
SCANNING RECEIVER

GREAT PRICE!

ICOM IC-3210
138-174 MHzDUAL BAND
FM TRANSCIVER

GREAT PRICE

All Major Brands in Stock Now!

Bob Ferrero W6RJ
President
Jim Rafferty N6RJ
VP So. Calif Div.
Anaheim Mgr.ANAHEIM, CA 92801
2620 W. La Palma
(714) 761-3033, (213) 860-2040
Between Disneyland &
Knott's Berry FarmATLANTA, GA 30340
6071 Buford Hwy.
(404) 263-0700
Larry, Mgr. WD4AGW
Doraville, 1 mi. north of I-285BURLINGAME, CA 94010
999 Howard Ave.
(415) 342-5757
George, Mgr. WB6DSV
5 miles south on 101 from SFOOAKLAND, CA 94606
2210 Livingston St.
(415) 534-5757
Al, Mgr. WA6SYK
17N-5th Ave./17S-16th Ave.PHOENIX, AZ 85015
1702 W. Camelback Rd.
(602) 242-3515
Bob, Mgr. K7RDH
East of Hwy. 17SAN DIEGO, CA 92123
5375 Kearny Villa Rd.
(619) 560-4900
Tom, Mgr. KM6K
Hwy. 163 & Claremont Mesa Blvd.VAN NUYS, CA 91411
6265 Sepulveda Blvd.
(818) 988-2212
Al, Mgr. KB7RA
San Diego Fwy
at Victory Blvd.STORE HOURS
10 AM-5:30 PM
CLOSED SUNDAYSOUTSIDE
CALIFORNIA

CALL TOLL FREE (800) 854-6046

INSIDE CALIFORNIA CALL STORES DIRECT

Toll free including Hawaii. Phone Hrs: 7:00 am to 5:30 p.m. Pacific Time. California, Arizona and Georgia customers call or visit nearest store.
California, Arizona and Georgia residents please add sales tax. Prices, specifications, descriptions subject to change without notice.

DAYTON Hamvention

April 28, 29, 30, 1989

Early Reservation Information

• General Chairman, Bill McNabb, WD8SAY

• Asst. General Chairman, Ed Hillman, N8ALN

- **Giant 3 day flea market • Exhibits**
- **License exams • Free bus service**
- **CW proficiency test • Door prizes**

Flea market tickets and grand banquet tickets are limited. Place your reservations early, please.

Flea Market Tickets

A maximum of 3 spaces per person (non-transferable). Tickets (valid all 3 days) will be sold IN ADVANCE ONLY. No spaces sold at gate. Vendors MUST order registration ticket when ordering flea market spaces.

Special Awards

Nominations are requested for 'Radio Amateur of the Year,' 'Special Achievement' and 'Technical Achievement' awards. Contact: Hamvention Awards Chairman, Box 964, Dayton, OH 45401.

License Exams

Novice thru Extra exams scheduled Saturday and Sunday by appointment only. Send FCC form 610 (Aug. 1985 or later) - with requested elements shown at top of form, copy of present license and check for prevailing ARRL rates (payable to ARRL/VEC) to: Exam Registration, 8830 Windbluff Point, Dayton, OH 45458

1989 Deadlines

Award Nominations: March 15

Lodging: April 7

License Exams: March 26

Advance Registration and banquet:

USA - April 4 Canada - March 31

Flea Market Space:

Spaces will be allocated by the Hamvention committee from all orders received prior to February 1. Express Mail *NOT* be necessary! Notification of space assignment will be mailed by March 15, 1989.

Information

General Information: (513) 433-7720
or, Box 2205, Dayton, OH 45401

Lodging Information: (513) 223-2612
(No Reservations By Phone)

Lodging

Please write to **Lodging, Dayton Hamvention, Chamber Plaza, 5th & Main Streets, Dayton, OH 45402** or refer to our 1988 Hamvention program for lodging information which includes a listing of hotel/motels located in the surrounding areas of Dayton. Reservations for the surrounding area will then become the responsibility of the individual.

HAMVENTION is sponsored by the Dayton Amateur Radio Association Inc.

Advance Registration Form

Dayton Hamvention 1989

Reservation Deadline - USA-April 4, Canada-March 31

Flea Market Reservation Deadline: February 1

Enclose check or money order for amount indicated and send a self addressed stamped envelope.

Please Type or Print your Name and Address clearly.

How Many

Admission (valid all 3 days)	_____	@ \$10.00*	\$ _____
Grand Banquet	_____	@ \$20.00**	\$ _____
Women's Luncheon (Saturday)	_____	@ \$7.00	\$ _____
(Sunday)	_____	@ \$7.00	\$ _____
Flea Market (Max. 3 spaces)	_____	\$25/1 space \$50/2 adjacent	\$ _____
Admission ticket must be ordered with flea market tickets	_____	\$150/3 adjacent	\$ _____
		Total	\$ _____

* \$12.00 at door

** \$22.00 at door, if available

Name _____

Address _____

City _____ State _____ Zip _____

Make checks
payable to -

Dayton HAMVENTION

Mail to -

**Dayton Hamvention
Box 2205
Dayton, OH 45401**

ANTENNA ARRAY PATTERNS

WITH A PERSONAL COMPUTER

By Dennis D. King, KC7MT, 2204 East 10225 South, Sandy, Utah 84092

Program generates data for tabular or graphic display

I have enjoyed many of the antenna articles presented in *Ham Radio* magazine, but a practical grasp of the basic dynamics of antenna patterns always remained elusive. "ARRAY" gives you hands-on experience in antenna array basics and ground effects.

The computer program, written in BASIC for an IBM PC compatible, runs in Microsoft BASIC. Commands are generic and the program is easily modified to work with other BASIC interpreters.

program description

The operator loads in the currents, phase relationships, and spacings of any number of elements. The elements can be either omnidirectional or half-wave dipoles. If desired a perfect ground plane can be located parallel to the array. Next, the operator enters the distance to the ground plane as well as the antenna polarization. The resulting antenna pattern is then calculated and plotted in BASIC graphics on the screen. Two automatically scaled plots are available — field strength, and a log plot showing 25 dB of the pattern. This flexible program can look at both the vertical and horizontal electric field patterns of a beam located a fixed distance above a ground plane. It is menu-oriented with continuous prompts. A parameter change section allows for quick substitutions

of any parameter without reloading all of the array information.

Program speed varies with the number of elements chosen. Most plots take less than 30 seconds to calculate. The program was written to be compatible with IBM/Microsoft BASIC compilers; using a compiler can speed things up significantly.

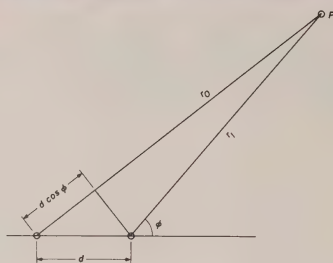
program construction

"ARRAY" is divided into several subroutines that perform different functions. The array pattern is calculated in a subroutine at line 490. The program computes the field strength at each angle by summing the E-field generated by each element of the array. The E-field contains both amplitude and phase information. **Figure 1** shows the geometry involved in calculating the field strength at a distant point P.

As you see in the drawing, if P is far enough away, r_0 and r_1 are almost the same length. Since the signal strength varies slowly as a function of $1/r$, the relative signal strengths at P are proportional to the currents in the elements.

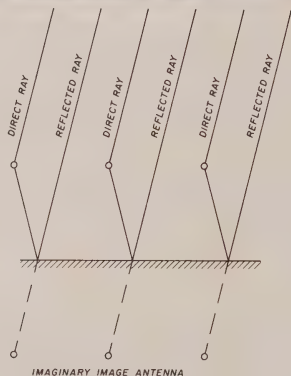
Phase changes rapidly with r — 360 degrees (2π radians) for every wavelength P is from an element. However, at P we are concerned only with the relative phase difference. **Figure 1** shows that the path length difference to P between two elements is $d \cos(\phi)$. β is defined as the rate of phase change, where $\beta = (2\pi/\text{wavelength})$. The amount of phase difference is therefore $\beta d \cos \phi$. Now we must add one more factor — the phase difference between the original element currents (α). So the final equation for the phase difference between any two elements at point P is: phase difference = $\beta d \cos \phi + \alpha$ where $\beta = (2\pi/\text{wavelength})$.

FIGURE 1



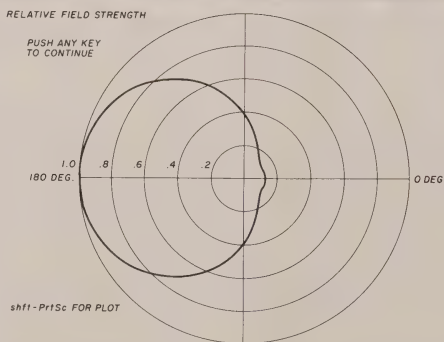
The geometry used with each element to calculate the field strength at point P.

FIGURE 2



Directed and reflected components from antenna elements. The latter appears to original form elements within the ground.

FIGURE 3



Three-element Yagi antenna pattern using omnidirectional elements.

For each radiation angle the program determines the relative magnitude and phase of each element, adds up the total, and places the result in array E. Because you can't add magnitude and phase in polar notation, the E-field values are first converted to rectangular coordinates, added, then reconverted back to polar magnitude.

Where elements are half-wave dipoles instead of omnidirectional elements, a factor is multiplied into each element to simulate the pattern and phase of dipole elements.

simulating ground effects

A ground plane reflects the downward directed energy from the elements. At point P there are *two* components from each element: the direct path signal and the reflected path signal. **Figure 2** illustrates this geometrical relationship. While a routine could be incorporated to add the magnitudes and phases of all the signals as in the original array calculations, there is an easier process that uses the concept of an image antenna and the method of antenna pattern multiplication.

If an array at distance h above the ground is replaced with two identically driven arrays spaced 2h apart, the signals arriving at point P are the same in both cases. The second imaginary antenna is called the image antenna.

Pattern multiplication is another method of antenna analysis. All the elements of an array are replaced with a single point antenna having the array's pattern. The image antenna is also replaced by this single point antenna. There are now two antenna "elements" spaced vertically 2h apart. Calculate the pattern of these two omnidirectional elements using pattern multiplication. Simply multiply the pattern of this two-element vertical array with the pattern of the original horizontal array to produce the overall antenna pattern. This method is rigorously correct and significantly reduces computation time.

When an electromagnetic wave hits a perfectly conducting ground, the horizontal (or tangential) component of the E-field cannot exist (must equal zero). Consequently the reflected wave must have an equal value and opposite phase horizontal component to produce this "zero" result. In other words, in the reflection process the E-field phase is reversed by 180 degrees — similar to an incident wave in a coax encountering a short circuit. In a vertically polarized incident electromagnetic wave, the E-field is vertical and *not* shorted out by the conducting plane. The phase is not reversed upon reflection — similar to an incident wave in a coax encountering an *open* circuit. Therefore, the polarization of incident signals significantly affects the phase of the reflected signal. To compensate for this, the program adds 180 degrees

FIGURE 4

3 Element linear array

Element	magnitude	phase(DEG)	separation
1	.662	0	n/a
2	1	110.33	.15
3	.5	244.5	.1

Array elements are omnidirectional.
 Step size for analysis is currently 1 degrees.
 Ground plane is 1 wavelengths below the array.
 Array elements are horizontally polarized.

Do you want to change:

E-element parameters

G-toggle presence or absence of ground plane

P-toggle polarization of elements

H-change distance from array to ground plane

D-toggle omnidirectional elements or 1/2 wave dipole elements

S-change step size of analysis

A-analyze

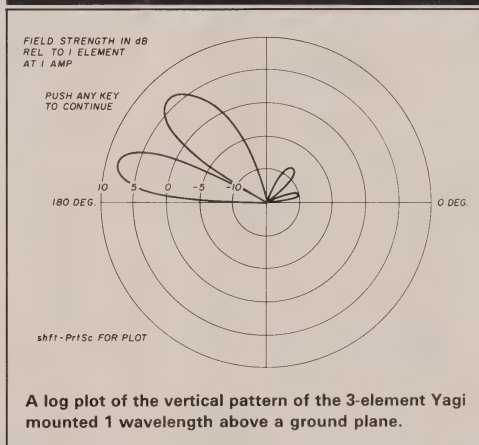
Screen display of change menu.

to the image antenna drive when the polarization is horizontal.

The "ARRAY" program assumes that the ground plane is an ideal conductor. In practice this is never true. The reflectivity of the earth is a function of the local complex dielectric constant (ϵ) for a given frequency. While it varies geographically, in general the lower the frequency the more ideal the earth appears. The reflectivity also varies with the incident angle. For horizontal polarization, the closer the angle is to the horizon, the closer the earth appears as an ideal conductor and the more accurate the program. Below 10 degrees or so it is virtually always accurate. For vertical polarization, the higher the angle is above the horizon, the more accurate the program. Something strange happens with vertical polarization at low angles. At angles below 20 degrees or so, the phase of the vertically polarized reflected wave is actually shifted 180 degrees, just as one would expect with horizontal polarization! As the angle increases, the reflected signal phase quickly shifts 180 degrees back to nearly 0. Therefore, for low angles, it is actually more realistic to model real-world vertical polarization patterns by specifying horizontal polarization. This is one reason why it is so important for a vertically polarized antenna to have a good ground plane if you want significant signal energy gain at low angles.

Even though the earth is not an ideal ground plane, the program is still useful in determining the location of peaks and nulls. In general, with the non-ideal earth, the location of the peaks and nulls will remain approx-

FIGURE 5



imately correct but the amplitude of the peaks and depth of the nulls will be diminished.

plotting

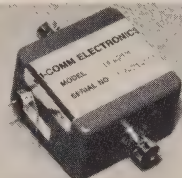
Plotting routines are provided by lines 1150 and 1630. They are polar plotters converting the angle and magnitude to x,y coordinates and plotting the results on the screen. Both contain auto-scaling. The field strength plot routine scales the field strength amplitudes so that the highest level is 1.0. The log plotter logs the data and scales it so that the highest 25-dB range is plotted.

5-1000 MHZ PREAMPLIFIERS

	NF	G	P(1dB)	\$
WLA21m	3dB	13dB	8dBm	57
WLA22m	4	11	12	61
WLA23m	4	23	12	87
WLA24m	3	20	18	109

430/50MHZ CONVERTER

RCX431	.15 μ V	20dB	99
--------	-------------	------	----



WILAM TECHNOLOGY, Div. of
WI-COMM ELECTRONICS INC.
 P.O. Box 5174, MASSENA, N.Y. 13662
 (315) 769-8334

✓ 123

ANTENNA MODELING



Easy to use, with menus, and optional mouse. Enter parameters, and get a color coded sinusoidal projection of a MW or SW antenna. Move over the projection with a mouse or cursor and read the gain at that point.

LONG WIRE PRO models long wires, vee's, dipoles, and rhombics displaying a sinusoidal projection. \$40

VERTICAL PRO models single verticals or arrays displaying a sinusoidal projection, a ground wave plot, and the impedance of each element. \$80

IBM PC compatible, DOS 2.0 or higher, 256K, CGA or EGA color required. International orders add \$5 shipping.



EPSILON CO

Box 715, Trumbull CT, 06611, (203) 261-7694

✓ 124

Subscribe Today

Call Toll Free
(orders only)

1 (800) 341-1522

Have your credit card
ready
Ham Radio Magazine

FIGURE 6

The "ARRAY" program.

```

10 .....
20 'I .....
30 'I .....
40 'I .....
50 'I .....
60 'Main Program
80 DIM E(361),UNIT(361),L(361),M(25),THETA(25),D(25)
90 GOSUB 170 'Get input parameters
100 GOSUB 490 'Calculate field strength
110 GOSUB 3380 'Print main menu
120 AS=INKEY$:IF AS="" THEN 120 'Input menu choice
130 P=VAL(AS)
140 ON P GOSUB 1150,1630,2170,90,2740,2150
150 GOTO 110
160 '.....
170 'Getting input parameters
180 CLS:INPUT"How many elements in this linear array?";E
190 CLS:PRINT"What is the magnitude of element 1 current?"
200 PRINT"(1 amp is often convenient, it need only be relative)"
210 INPUT M(1) 'M(?) defines the element currents
220 FOR J=2 TO E
230 PRINT"What's the magnitude of element current ";J;" rel to element 1?"
240 INPUT M(J)
250 PRINT"What is the phase(in deg) of element ";J;" rel. to element 1?"
260 INPUT THETA(J)
270 PRINT"How many wavelengths from element ";J;" to element ";J-1;"?"
280 INPUT D(J-1)
290 NEXT J
300 CLS:PRINT:PRINT"Is each element:":PRINT"O-omnidirectional or;"
310 PRINT"D-a half wave dipole"
320 AS=INKEY$:IF AS="" THEN 320
330 IF AS="o" OR AS="O" THEN EL=0:GOTO 360
340 IF AS="d" OR AS="D" THEN EL=1:GOTO 360
350 GOTO 300
360 CLS:INPUT"What step size in degrees for the analysis?";ST
370 CLS:PRINT:INPUT"Is there a ground plane beneath the array(Y/N)";AS
380 IF AS="y" OR AS="Y" THEN 400
390 GP=0:END=360:RETURN 'GP indicates existence of ground plane
400 GP=1:END=180
410 INPUT"How many wavelengths below the array is the ground plane?";GPWL
420 PRINT:PRINT"Are the array elements:":PRINT"H-Horizontally polarized or;"
430 PRINT"V-Vertically polarized?"
440 AS=INKEY$:IF AS="" THEN 440
450 IF AS="h" OR AS="H" THEN POL=0:RETURN
460 IF AS="v" OR AS="V" THEN POL=1:RETURN
470 GOTO 420
480 '.....
490 'Calculating field strength for each degree of angle
500 'Output is E(0-359)
510 CLS
520 FOR DEG=0 TO END STEP ST
530 LOCATE 12,25:PRINT"Working on ";DEG;" degree angle."
540 ANG=DEG/57.2975 'converts degrees to radians
550 COS(COS(ANG))
560 IF EL=1 THEN SI=SIN(ANG*(1.5708)):IF ABS(SI)<.001 THEN RT=0:GOTO 610
570 'that statement defined sin(angle*90 degrees) for later
580 :IF EL=1 THEN GOSUB 1090:RT=M(1)*MDIP:GOTO 610
590 'that statement defined the mag. of element pattern if dipole
600 RT=M(1)
610 IT=0:D=0
620 FOR I=2 TO E
630 D=D+(I-1)
640 IF EL=1 AND ABS(SI)<.001 THEN MAG=0:GOTO 670
650 IF EL=1 THEN GOSUB 1090:MAG=M(I)*MDIP:GOTO 670
660 MAG=M(I)
670 THET=THETA(I)+6.283*D*CO*57.2975
680 GOSUB 1010 'changing mag and phase to rectangular
690 RT=RT*REAL:IT=IT*IM
700 NEXT I
710 REAL=RT:IM=IT
720 GOSUB 1060 'changing from rect back to polar
730 E(DEG)=MAG
740 NEXT DEG
750 IF GP=1 THEN GOSUB 780 'this does the ground plane calcs
760 RETURN
770 '.....
780 'this sub accommodates ground plane in field
790 'generate image pattern
800 MAG=1:IF POL=0 THEN THETA=180 'accounts for phase of ref. due to polarity
810 IF POL=1 THEN THETA=0
820 FOR DEG=0 TO 360 STEP ST
830 CO=COS((DEG-90)/57.2975)'this rotates pattern -90 deg
840 D=2*GPWL
850 LOCATE 12,22:PRINT"Working on image pattern, ";DEG;" degrees."
860 MAG=1:THET=THETA+6.283*D*CO*57.2975
870 GOSUB 1010 'polar to rect
880 RT=1*REAL:IT=1*IM
890 REAL=RT:IM=IT
900 GOSUB 1060 'changing rect to polar
910 UNIT(DEG)=MAG
920 NEXT DEG
930 'we now have image pattern
940 'multiplying image and array patterns
950 FOR DEG=0 TO END STEP ST
960 E(DEG)=E(DEG)*UNIT(DEG)
970 NEXT DEG
980 RETURN
990 '.....
1000 'changing polar coordinates MAG AND THET to rectangular REAL AND IM
1010 REAL=MAG*COS(THET/57.2975)

```

```

1020 IM=MAG*SIN(THET/57.2975)
1030 RETURN
1040 '-----
1050 'changes rectangular coordinates REAL AND IM to magnitude MAG
1060 MAG=(REAL^2+IM^2)^(.5) 'changes rectangular to magnitude
1070 RETURN
1080 '-----
1090 'this sub returns a value MDIP which is the gain factor of dipole element
1100 MDIP=1/(COS(1.57-COS(ANG+1.5708)))^5
1110 RETURN
1120 '-----
1130 '
1140 '-----
1150 'plotting field strength data
1160 SCREEN 2:CLS
1170 CIRCLE (320,100),239
1180 CIRCLE (320,100),192
1190 CIRCLE (320,100),144
1200 CIRCLE (320,100),96
1210 CIRCLE (320,100),48
1220 LINE (80,100)-(560,100)
1230 LOCATE 23,1:PRINT"shft-PrtSc for plot"
1240 LOCATE 3,2:PRINT"Push any key"
1250 LOCATE 4,2:PRINT"To continue"
1260 LINE (320,0)-(320,200)
1270 LOCATE 13,72:PRINT"0 deg"
1280 LOCATE 12,10:PRINT"1"
1290 LOCATE 12,15:PRINT".8"
1300 LOCATE 12,21:PRINT".6"
1310 LOCATE 12,27:PRINT".4"
1320 LOCATE 12,33:PRINT".2"
1330 LOCATE 1,2:PRINT"Relative Field Strength"
1340 LOCATE 13,3:PRINT"180 deg."
1350 GOSUB 1470 'sizing data, finding min and max
1360 SCALE=1/MAX 'scale factor to make max=1
1370 X1=320:Y1=100
1380 FOR DEG=0 TO EEND STEP ST
1390 M=SCALE*(E(DEG):A=DEG
1400 GOSUB 1550
1410 LINE (X1,Y1)-(X,Y) 'draws lines between x1 y1 points
1420 X1=X:Y1=Y
1430 NEXT DEG
1440 AS=INKEY$:IF AS="" THEN 1440
1450 RETURN
1460 '-----
1470 'this sub sizes the data, finds min and max
1480 MIN=1000000:MAX=-1000000
1490 FOR DEG=0 TO EEND STEP ST
1500 IF MAX<E(DEG) THEN MAX=E(DEG)
1510 IF MIN>E(DEG) THEN MIN=E(DEG)
1520 NEXT DEG
1530 RETURN
1540 '-----
1550 'this sub returns x,y coordinates for unit plot
1560 'given inputs of magnitude M and angle A in degrees
1570 X=320+240*M*COS(A/57.2975)
1580 Y=100-100*M*SIN(A/57.2975)
1590 RETURN
1600 '-----
1610 '
1620 '-----
1630 'Plotting in dB the highest 25 db of magnitude data
1640 GOSUB 1990 'logging data
1650 GOSUB 2080 'determines scale
1660 SCREEN 2:CLS
1670 CIRCLE (320,100),239
1680 CIRCLE (320,100),192
1690 CIRCLE (320,100),144
1700 CIRCLE (320,100),96
1710 CIRCLE (320,100),48
1720 LINE (80,100)-(560,100)
1730 LOCATE 23,1:PRINT"shft-PrtSc for plot"
1740 LOCATE 5,2:PRINT"Push any key"
1750 LOCATE 6,2:PRINT"To continue"
1760 LINE (320,0)-(320,200)
1770 LOCATE 13,72:PRINT"0 deg"
1780 LOCATE 12,10:PRINT"OUTRING"
1790 LOCATE 12,15:PRINT"OUTRING-5"
1800 LOCATE 12,21:PRINT"OUTRING-10"
1810 LOCATE 12,27:PRINT"OUTRING-15"
1820 LOCATE 12,33:PRINT"OUTRING-20"
1830 LOCATE 1,2:PRINT"Field Strength in db"
1840 LOCATE 2,2:PRINT"Rel to 1 element"
1850 LOCATE 3,2:PRINT"At 1 amp"
1860 LOCATE 13,3:PRINT"180 deg."
1870 SCALE=1/25
1880 X1=320:Y1=100
1890 FOR DEG=0 TO EEND STEP ST
1900 M=SCALE*((L(DEG)-OUTRING+25)):A=DEG 'this scales data
1910 IF M<0 THEN M=0
1920 GOSUB 1550
1930 LINE (X1,Y1)-(X,Y)
1940 X1=X:Y1=Y
1950 NEXT DEG
1960 AS=INKEY$:IF AS="" THEN 1440
1970 RETURN
1980 '-----
1990 'this sub changes the data to db's rel to single element
2000 MIN=1000000:MAX=-1000000
2010 FOR DEG=0 TO EEND STEP ST
2020 IF E(DEG)>0 THEN L(DEG)=100:GOTO 2040
2030 L(DEG)=8.686+LOG(E(DEG))

```

MADISON SHOPPER

CALL FOR ORDERS

1 (800) 231-3057
1-713-520-7300 OR 1-713-520-0550
TEXAS ORDERS CALL COLLECT
FAX 1-713-771-7759

ALL ITEMS ARE GUARANTEED OR
SALES PRICE REFUNDED



New Icom IC 781 Trades wanted
Kenwood TH215A, TH25AT Trade in your old HT
TS440 S/AT Call



Kenwood TS 140S Call for trade
New Kenwood TM-721A, mobile Call



TS 790A Super 2 Meter 70 cm Rig.
1.2 GHz Option Available Call
ICOM 228H/ITM 449.00
Icom 761 2300.00
External relay box
Specify Radio and Amps. Call
HEIL BM10 Boom Mike, wired 8 pin 69.00
HEIL HM5 Desk Mike 62.00
NYE MB5A Tuner 569.00
Alpha Delta Transistap HV 33.00
CSI Private Patch IV 469.00
Ameco PT 3 Pre Amp 99.00
Larsen 2-meter on glass 49.95
Anleco 2M, 5/8, Mag. Mount, Comp 25.00
Van Gordon G5RV 44.00
Bird 43, elements/stock Call
Thousands of panel meters 3.95 up CALL
Belden 9913, 8267, 8214 Stock Call
New Ten Tec Omni V DX rig extraordinaire 1895.00
MICA Capacitors Call
Arista SWR Bridge 3:30 MHz 19.95
831SP-PL259 Silverplate (Amphenol) 1.50
82-61 N Male (Amphenol) 3.50
82-202-1006 N Male (9913) 3.50
Double Female UHF 1.00
UG176 RG8X each 40
Surplus Elbow PL259-50239 each \$1
Receiving tubes 50-90% off list price Call
Santec Boom Mike/Headset (fits ICOM) 20.00
Rohn SA 25G 67 (67 inside arm) each 125.00

USED EQUIPMENT

All equipment, used, clean, with 90 day warranty and 30 day trial. Six months full trade against new equipment. Sale price refunded if not satisfied.
(800) 231-3057

Don's Corner:

Use it or lose it!

Our new WARC bands are far from fully occupied. If we don't get on the stick and keep them active, other interests are going to petition the FCC to reallocate them! What is it going to take?

Spring is just around the corner. Start planning your antenna projects now! Call today and order your new antennas and hardware. Madison is your one-stop ham superstore.

POLICIES

Minimum order \$10.00. Mastercard, VISA, or C.O.D. All prices FOB Houston, except as noted. Prices subject to change without notice. Items subject to prior sale. Call anytime to check the status of your order. Texas residents add sales tax. All items full factory warranty plus Madison warranty.

Bird and Belden products in stock. Call today.

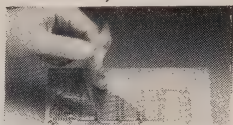
MADISON

Electronics Supply

3621 FANNIN
HOUSTON, TEXAS 77004



MAKE CIRCUIT BOARDS THE NEW, EASY WAY



WITH TEC-200 FILM

JUST 3 EASY STEPS:

- Copy circuit on TEC-200 film using any plain paper copier
- Iron film on to copper clad board
- Peel off film and etch

SATISFACTION GUARANTEED
convenient 8½ x 11 size

5-Sheets for \$3.95
10 sheets only \$5.95

add \$1.25 postage — NY res. add sales tax

The MEADOWLAKE Corp.

DEPT. M, P.O. Box 497
Northport, New York 11768

✓ 126

VHF-UHF POWER DIVIDERS



RF power dividers provides the best way to feed in-phase 2 and 4 antenna arrays to maximize system gain and at the same time reduce losses to a minimum. Covering 144 thru 1296 MHz, this series of VHF/UHF power dividers are premier RF devices designed for a long service life with low SWR and broad operating bandwidth.

Extruded aluminum body with a durable enamel finish in addition to silicon sealing at connector flanges results in a ruggedized unit for all array installations. Available with N-type connectors only, these units are unconditionally guaranteed for 2 years.

MODEL	CONFIG.	PRICE
144-2P	(2 ports)	\$54.00
144-4P	(4 ports)	\$61.00
220-2P	(2 ports)	\$53.00
220-4P	(4 ports)	\$60.00
430-2P	(2 ports)	\$51.00
430-4P	(4 ports)	\$59.00
902-2P	(2 ports)	\$51.00
902-4P	(4 ports)	\$59.00
1296-2P	(2 ports)	\$52.00
1296-4P	(4 ports)	\$60.00

SHIPPING NOT INCLUDED

STRIDSBURG ENGINEERING, CO.

P.O. Box 7973 • Shreveport, LA 71107 • USA
Phone: (318) 865-0523

✓ 127

QuicKit™ GSRV, Loop, & Dipole Kits

- Fast & Easy to Build
- Everything included
- Fail-safe visual instructions
- No measuring / cutting
- Finish antenna in minutes
- Quality Components**
- Presoldered Amphenol PL259
- Kingproof Superflex wire
- Fully insulated, low noise design, no-corrode, low noise design
- Fastest Antennas in the West**
- Full Size GSRV dipole coverage 80-100
- Half Size GSRV dipole coverage 40-100
- Quarter Size GSRV dipole coverage 20-100
- Marconi Adapter kit \$ 4.95
- Antenna Launcher kit \$14.95
- 200 Dacron 500W line \$11.95
- Loops, dipoles, feedlines, etc.
- Add \$5 Shipping & Handling
- Catalog \$1 by 1st class mail

Antennas West
(801) 373-8425 Box 50062-H, Provo, UT 84605

✓ 128

```

2040 IF MAX<L(DEG) THEN MAX=L(DEG)
2050 IF MIN>L(DEG) THEN MIN=L(DEG)
2060 NEXT DEG
2070 '-----
2080 'this sub determines the scaling
2090 OUTRING=5*INT(MAX/5)+5 'outring is the nearest 5db increment
2100 CENT=OUTRING-25
2110 RETURN
2120 '-----
2130 '-----
2140 '-----
2150 SYSTEM 'sends execution back to dos
2160 '-----
2170 'printing out data
2180 CLS:GOSUB 1990 'logging data
2190 PRINT"do you want to:"PRINT" S-print on screen":
2200 PRINT" P-print out on printer"
2210 PRINT" Q-quit"
2220 AS=INKEYS:IF AS="" THEN 2220
2230 IF AS="s" OR AS="S" THEN GOSUB 2460
2240 IF AS="p" OR AS="P" THEN GOSUB 2580
2250 IF AS="q" OR AS="Q" THEN RETURN
2260 GOTO 2170
2270 '-----
2280 'this sub prints the parameters on the screen
2290 PRINT:PRINT E;" Element linear array":PRINT
2300 PRINT"Element magnitude phase(DEG) separation"
2310 PRINT" 1,"M(1)," 0 n/a
2320 FOR I=2 TO E
2330 PRINT I,M(I),THETA(I),D(I-1)
2340 NEXT I
2350 PRINT
2360 IF EL=0 THEN PRINT"Array elements are omnidirectional."
2370 IF EL=1 THEN PRINT"Array elements have 1/2 wave dipole pattern."
2380 PRINT"Step size for analysis is currently ";ST;" degrees."
2390 IF GP=1 THEN 2410
2400 RETURN
2410 PRINT"Ground plane is ";GPWL;" wavelengths below the array."
2420 IF POL=0 THEN PRINT"Array elements are horizontally polarized."
2430 IF POL=1 THEN PRINT"Array elements are vertically polarized."
2440 RETURN
2450 '-----
2460 CLS'printing out on screen
2470 GOSUB 2280 'prints out parameters
2480 PRINT:PRINT"ANGLE FS(VOLTS) REL GAIN TO 1 ELEMENT(DB)
2490 PRINT
2500 FOR DEG=0 TO EEND STEP ST
2510 PRINT DEG,E(DEG);TAB(31) L(DEG)
2520 NEXT DEG
2530 PRINT"hit any key to continue"
2540 BS=INKEYS:IF BS="" THEN 2540
2550 RETURN
2560 '-----
2570 'printing out on printer
2580 CLS:PRINT"sending to printer"
2590 LPRINT E;" Element linear array":PRINT
2600 LPRINT"Element magnitude phase separation"
2610 LPRINT" 1 1 0 N/A"
2620 FOR I=2 TO E
2630 LPRINT E,M(I),THETA(I),D(I-1)
2640 NEXT I
2650 LPRINT:LPRINT"ANGLE FS(VOLTS) REL GAIN TO 1 ELEMENT(DB)
2660 LPRINT
2670 FOR DEG=0 TO EEND STEP ST
2680 LPRINT DEG,E(DEG);TAB(31) L(DEG)
2690 NEXT DEG
2700 RETURN
2710 '-----
2720 '-----
2730 '-----
2740 'change parameters
2750 GOSUB 2280 'prints out current parameters
2760 PRINT:PRINT"do you want to change:"
2770 PRINT"E-element parameters"
2780 PRINT"G-toggle presence or absence of ground plane
2790 PRINT"P-toggle polarization of elements
2800 PRINT"H-change distance from array to ground plane
2810 PRINT"D-toggle omnidirectional elements or 1/2 wave dipole elements"
2820 PRINT"S-change step size of analysis"
2830 PRINT"A-analyze"
2840 AS=INKEYS:IF AS="" THEN 2840
2850 IF AS="e" OR AS="E" THEN GOSUB 2990
2860 IF AS="g" OR AS="G" THEN GOSUB 3160
2870 IF AS="p" OR AS="P" THEN GOSUB 3210
2880 IF AS="h" OR AS="H" THEN GOSUB 3260
2890 IF AS="a" OR AS="A" THEN CLS:GOTO 100
2900 IF AS="d" OR AS="D" THEN GOSUB 3310
2910 IF AS="s" OR AS="S" THEN GOSUB 2940
2920 CLS:GOTO 2750
2930 '-----
2940 'changes step size of analysis
2950 CLS:PRINT"Step size is currently ";ST;" degrees."
2960 INPUT"what new step size in degrees";ST
2970 RETURN
2980 '-----
2990 'changes element parameters
3000 CLS:INPUT"which element to change";R
3010 CLS:PRINT:PRINT"element magnitude phase(deg) separation"
3020 PRINT R,M(R),THETA(R),D(R-1)
3030 PRINT
3040 PRINT"do you want to change:"
3050 PRINT"M-magnitude"
3060 PRINT"P-phase":PRINT"S-separation in wavelengths"

```

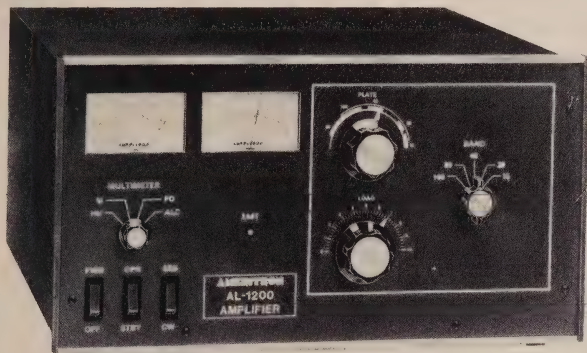


AL-80A LINEAR AMPLIFIER

The AL-80A will provide a signal output that is within 1/2 "S" unit of the signal output of the most expensive amplifier on the market—and at much lower cost.

The Ameritron AL-80A combines the economical 3-500Z with a heavy duty tank circuit to achieve nearly 70% efficiency from 160 to 15 meters. It has wide frequency coverage for MARS and other authorized services. Typical drive is 85 watts to give over 1000 watts PEP SSB and 850 watts CW RF output. A new Pi-L output circuit for 80 and 160 gives full band coverage and exceptionally smooth tuning.

Size: 15 1/2" D. x 14" W. x 8" H. Wgt. 52 lbs.



AL-1200 LINEAR AMPLIFIER 3CX1200 TUBE

Full legal output with 100 watts drive.

AL-1500 LINEAR AMPLIFIER 8877 TUBE

Full legal output with 65 watts drive.

The cooling system in both amplifiers keeps the tube safely below the manufacturers ratings even when operating at 1500 watts output with a steady carrier. The filament supply has inrush current limiting to insure maximum tube life.

Size: 18 1/2" D. x 17" W. x 10" H. Wgt. 77 lbs.



AL-84 LINEAR AMPLIFIER

The **Ameritron AL-84** is an economical amplifier using four 5MJ6 tubes to develop 400 watts output on CW and 600 watts PEP on SSB from 160 through 15 meters. Drive required is 70 w typical, 100 w max. The passive input network presents a low SWR input to the exciter. Power input is 900 watts. The AL-84 is an excellent back-up, portable or beginner's amplifier.

Size: 11 1/2" W. x 6" H. x 12 1/2" D. Wgt. 24 lbs.

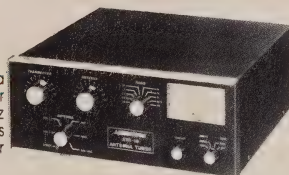
ATR-15 TUNER

The **Ameritron ATR-15** is a 1500 watt "T" network tuner that covers 1.8 through 30 MHz in 10 dedicated bands. Handles full legal power on all amateur bands above 1.8 MHz.

Five outputs are selected from a heavy duty antenna switch allowing the rapid choice of three coax lines, one single terminal feed or a balanced output. An internal balun provides 1:1 or 4:1 ratios (user selectable) on the balanced output terminals.

A peak reading wattmeter and SWR bridge is standard in the ATR-15. It accurately reads envelope powers up to 2KW.

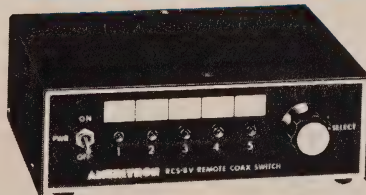
Size: 6" H. x 13 1/4" W. x 16" D. Wgt. 14 lbs.



RCS-4 FOR CONVENIENT INSTALLATION

No control cable required.
Selects one of four antennas
VSWR: under 1.1 to 1 from 1.8 to 30 MHz.
Impedance: 50 ohms.
Power capability: 1500 watts average, 2500 watts PEP maximum.

Remote COAX Switches



RCS-8V FOR SPECIAL APPLICATIONS

Selects up to five antennas.
Loss at 150 MHz: less than .1 dB.
VSWR: under 1.2 to 1 DC to 250 MHz.
Impedance: 50 ohms.
Power capability: 5 kW below 30 MHz, 1 kW at 150 MHz.

Available at your dealer. Send for a catalog of the complete AMERITRON line.

AMERITRON®

2375 Dorr Street • Toledo, OH 43607

For more information: (601) 323-9715 • Technical inquiries: (419) 531-3024


```

3070 PRINT"F-finished"
3080 AS=INKEYS:IF AS="" THEN 3080
3090 IF AS="m" OR AS="M" THEN INPUT"What is new magnitude";M(R):GOTO 3010
3100 IF AS="p" OR AS="P" THEN INPUT"What new phase(in deg)";THETA(R):GOTO 3010
3110 IF AS="s" OR AS="S" THEN INPUT"What new separ.(in wvlths)";D(R-1):GOTO 3010
3120 IF AS="i" OR AS="I" THEN RETURN
3130 GOTO 3010
3140 RETURN
-----
3150 '-----
3160 'toggles presence of ground plane
3170 IF GP=1 THEN GP=0:EEND=360:RETURN
3180 IF GP=0 THEN GP=1:EEND=180:RETURN
3190 RETURN
-----
3210 'toggles polarization of elements
3220 IF POL=0 THEN POL=1:RETURN
3230 IF POL=1 THEN POL=0:RETURN
3240 RETURN
-----
3250 '-----
3260 'changes distance from ground
3270 PRINT
3280 INPUT"What is new distance from array to ground in wavelengths";GPWL
3290 RETURN
-----
3300 '-----
3310 'toggles omni or dipole element patterns
3320 IF EL=1 THEN EL=0:RETURN
3330 IF EL=0 THEN EL=1:RETURN
3340 RETURN
-----
3350 '-----
3360 '
3370 '.....
3380 'This sub prints the main menu
3390 CLS:PRINT"Do you want to :":PRINT " 1-plot field strength data"
3400 PRINT " 2-plot data in db"
3410 PRINT " 3-print out data":PRINT " 4-start over "
3420 PRINT " 5-Change Parameters":PRINT " 6-quit"
3430 RETURN
3440 '.....

```

printing

The calculated patterns can be displayed on the screen or sent to a printer. The output contains each data point in both field strength and dB.

changing parameters

The change parameters routine, located at line 2740, is most worthwhile feature of "ARRAY". It allows the operator to change any of the antenna parameters easily and analyze the new data quickly.

BASIC compatibility

These are the only non-generic basic statements used: "Screen 2", which places Microsoft BASIC in high resolution graphics mode; "LINE", which draws lines between two screen coordinates; and "CIRCLE", which draws a circle of a given radius at a designated screen location. The plot routines are written around standard IBM graphics providing a resolution of 640 by 200. These commands should be easily adaptable for noncompatible forms of BASIC. The circles routine is not essential.

example

There have been some great articles in *Ham Radio* on Yagi antennas. While somewhat difficult, it is possible to derive the driven and induced currents in a Yagi array. Walter Schulz² described a three-element Yagi and calculated the element currents. Since the log plotter in the program uses 1 A in one element as a reference for 0 dB, the element currents are scaled so that the driver current is 1 A. The values for this three-element Yagi are:

Element	Current	Rel Phase	Separation in wavelengths
1	0.662	0	N/A
2	1.0	110.33	.15
3	0.5	244.5	.1

The program can first look at the vertical (from the side) field strength pattern

in free space. Omnidirectional elements are used because each dipole element appears omnidirectional from the side of the Yagi.

Figure 3 is the resulting field strength plot. An ideal ground plane can now be added. Assume the Yagi is horizontally polarized and mounted 1 wavelength off the ground. (This is equivalent to 65 feet for a 20-meter beam.)

Figure 4 is the menu displayed for adding the ground plane and associated parameters.

Figure 5 shows the resulting field strength plotted with the log plot routine. On the plot, 0 dB is the field strength that one element in free space would have with the same drive current of 1 A. On 20 meters the Yagi's primary lobe fires upward about 14 degrees.

conclusion

The "ARRAY" program, fig. 6, was primarily developed as an educational tool and will help anyone with a personal computer gain insight into antennas and resulting patterns. I'd be interested in receiving any comments, corrections to the program, or suggestions on possible improvements.

A written copy with comments and a 5-1/4 inch MS-DOS DSDD floppy containing the program is available from the author for \$15.00.

reference

1. Walter Schulz, Jr., "Key to 3-Element Yagi Design," *Ham Radio*, March 1984, pages 48-51.

bibliography

- Edward Jordan, Keith Balmain, "Electromagnetic Waves and Radiating Systems," Prentice-Hall, Inc., 1968.

Article G

HAM RADIO

SHORT CIRCUIT HOTLINE

Building a current ham radio project? Call the Short Circuit Hotline any time between 9 AM and Noon, or 1 to 3 PM — Eastern time — before you begin construction. We'll let you know of any changes or corrections that should be made to the article describing your project.

(See "Publisher's Log," April, 1984, page 6, for details.)

603-878-1441

A 220-MHZ 9600-BAUD DATA RADIO SYSTEM FOR PACKET

By Fred B. Cupp, W2DUC, 27 Crescent Road, Fairport, New York 14450

Techniques, equipment, and software for Amateur Packet Radio evolved in response to the medium's emerging needs. In packet's early days, the development of a dedicated controller, or TNC, presented a major stumbling block. Once this problem was overcome, the TNC was used with conventional 2-meter FM radios and telephone-type 1200-baud modems to get stations on the air and communicating.

The Packet Bulletin Board System, or BBS, was the next innovation. The WØRLI operating system, developed for the Xerox 820 computer board, has set a "de facto" standard for BBS software running on other machines — usually an IBM PC or clone. These BBS's have made mail forwarding on VHF a practical reality. They serve as local information centers and Amateur electronic mail networks.

Now there's interest in the formation of true electronic networks which will use intelligent node controllers to handle the traffic between distant stations automatically. There are still many questions to be answered, but at least three distinct groups are working on particular networking methods. But in the midst of all this activity, there's one item which seems to have been overlooked.

Dedicated high-speed radio links will be needed for network support, no matter what protocol finally emerges as the standard. There have been several complete radio modems advertised in ham magazines recently, but the cost of these units is rather steep compared to what we pay for the rest of our packet gear. In search of a low-cost alternative, N2AMK and I began experimenting with high-speed packet in the spring of 1987. Here are the methods and equipment we tried for running 9600 baud on 220 MHz using modified commercially available equipment.

One of the ways used to encode digital data on an RF carrier, Audio Frequency Shift keying (AFSK), is rather wasteful of bandwidth. Audio Phase Shift Keying (APSK) is better, but still isn't the ultimate. Current literature indicates that direct frequency modulation of the carrier by a digital signal is the most efficient method, especially in the presence of noise as the signal gets weaker.

To reduce the bandwidth of the transmission, you can filter the digital signal to limit the spectrum without significantly reducing the effectiveness of the received signal. Actually, this may be considered "rate-limited frequency shift keying." The trick is in the receiving end, where it's necessary to establish references for decoding the digital signal and regenerating the original TTL level signals.

For more information read "The TEXNET Packet Switching Network-part 2," published in *Ham Radio*, April 1987. Another good reference is the paper by Steve Goode, K9NG, in the fourth ARRL networking conference book. These articles provide good background on digital transmission and the problem of envelope or group delay. We've also included our own "Layman's Guide to Data Transmission" at the end of this article.

Group delay is also called "frequency/phase non-linearity." Simply stated, digital signals are comprised of a variety of frequencies depending on the number of "ones" and "zeros" in the data stream. If the higher frequencies pass through the system with different time delays than the lower frequencies, the clock recovery and the decoding of the bit stream will be poor. There are two possible methods of correction.

The first method (used in TEXNET) is to insert frequency-variable time-delay circuits in the receiver

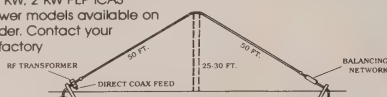
CONTINUOUS COVERAGE ANTENNAS FOR COMMERCIAL & AMATEUR SERVICE

Model AC 1.8-30

1.8 to 30 MHz

- SWR Max 2:1, 1.4:1 average from 1.8 to 30 MHz
- Can be installed in approximately 80 ft. space
- Ideal for commercial services for multi frequency operation without the need for antenna tuners or additional antennas
- Handles 1 KW, 2 KW PEP ICAS
- Higher power models available on special order. Contact your dealer or factory

\$175.00
SHIPPING & HANDLING
ADD \$4.00



U.S. Patent No. 4,511,898

Model AC 3.5-30

3.5 to 30 MHz

- SWR less than 2:1 from 3.5 to 30 MHz
- Complete assembled. Balun terminated with standard SO-239 connector
- Power capability 1 KW - 2 KW PEP ICAS. Higher power model is available on special order.
- Designed for 50 ohm feedline
- Weather proof balun and balancing network

\$184.50
SHIPPING & HANDLING
ADD \$4.00



U.S. Patent No. 4,423,423

ALL OUR PRODUCTS MADE IN USA



BARKER & WILLIAMSON

Quality Communication Products Since 1932

At your Distributors. Write or Call

10 Canal Street, Bristol, PA 19007

(215) 788-5581



output to correct or compensate for the distortion caused by the receiver IF filters. The second is to use a class of filters which have been designed for "flat" group delay. The advantage in using the second method is that it doesn't require adjustment to match the particular receiver IF.

We looked through several manufacturers' catalogs and found a class of IF filter intended for use in the digital control links of cellular telephones. The filters are produced by Murata-Erie, which also manufactures the filters used in the Hamtronics radios. The filter pinout and physical size are identical.

Armed with some sample filters, we got our project underway and built two systems — one at W2DUC, another at N2AMK. The test path was about 18 miles and over enough hills to require 10-watt "afterburners," especially during the summer when the trees were in leaf.

Design goals

In planning our tests, we decided not to use surplus equipment because we couldn't be sure others would be able to find the same parts. Instead, we used relatively standard parts and easy-to-obtain modules. Modular units let you make modifications without reworking a large unit.

Because we wanted a system that could be set up with a minimum of special test equipment, we had to keep the number of adjustments to a minimum.

Although TEXNET used the Hamtronics FM-5 transceivers, they've received some poor reviews when used in 9600-baud links. After talking with WA2GCF, Jerry Vogt of Hamtronics, we decided to choose separate modules for the exciter and receiver. These modules were better suited to the modifications we wanted to perform and were more stable than the earlier FM-5.

Our plan was to remove the phase modulator in the Hamtronics TA-51 exciter module. FM modulation is obtained by using a voltage variable capacitor (varicap) in the crystal oscillator circuit. Netting to frequency is achieved by summing the data with a DC voltage. You can use the optional speech input, as well as the digital data.

The receiver was very nearly "stock." We modified the squelch circuit to remove the hysteresis. The squelch signal was brought out to be used as the carrier detect input to the TNC. The discriminator output was brought out to the modem board, with the receiver audio left intact for voice use. For packet operation, simply turn down the volume control.

For the application in this article it's assumed that you are modifying a completely assembled pair of modules. If you're building a new kit, simply leave out the parts mentioned in the following changes.

**Make the
most of your
general
coverage
transceiver
with
Monitoring
Times!**

Every month Monitoring Times brings everything you need to make the most of your general coverage transceiver: the latest information on international broadcasting schedules, frequency listings, international DX reports, propagation charts, and tips on how to hear the rare stations. Monitoring Times also keeps you up to date on government, military, police and fire networks, as well as tips on monitoring everything from air-to-ground and ship-to-shore signals to radioteletype, facsimile and space communications.

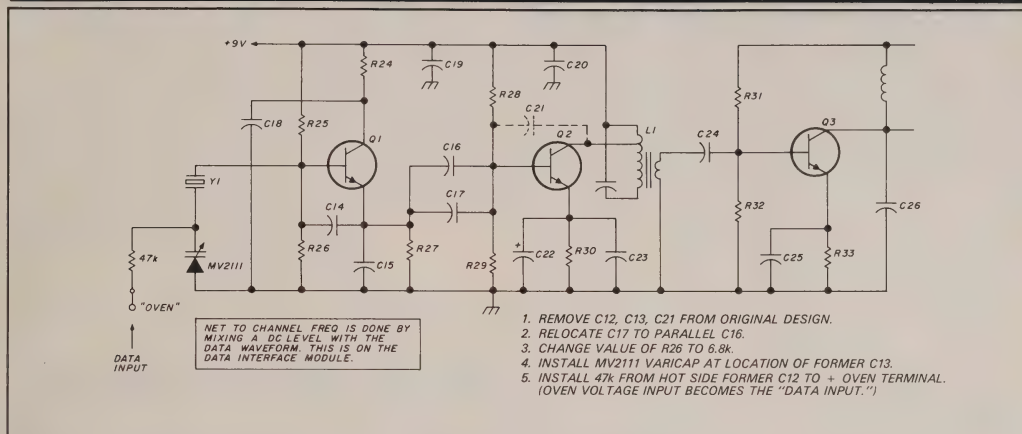
ORDER YOUR SUBSCRIPTION TODAY before another issue goes by. In the U.S., 1 year, \$18; foreign and Canada, 1 year, \$26. For a sample issue, send \$2 (foreign, send 5 IRCs). For MC/VISA orders (\$15 minimum), call 1-704-837-9200.

MONITORING TIMES

Your authoritative source,
every month.

P.O. Box 98 A 130
Brasstown, N.C. 28902

FIGURE 1



Changes to Hamtronics TA-51 220-MHz exciter for 9600-baud data transmission.

Exciter module changes

The exciters (from Hamtronics, Inc.) were originally built in the normal voice form. The radios were then tested on voice to assure proper operation. We discovered that the path was a little too rough and built a pair of 10-foot homebrew Yagis, which brought the signals up to usable voice quality. While some 9600-baud operation was possible, there was still enough noise on the signal to prevent perfect transmissions without retries. The 2 watts of the exciters just wasn't enough.

Adding the power amplifiers solved all the signal strength problems and also took care of the antenna switching (originally external to the modules). Antenna switching is included in the power amplifier modules.

As mentioned earlier, the major change was the conversion from phase modulation to direct FM. In the original circuit, Q2 was the phase modulator. The RF signal had two possible paths, one through Q2 and the other through capacitor C21. Varying the bias on Q2 caused a variation in the contribution of the two paths, which in turn caused a variation in the phase of the RF. Q2 was converted to a straight-through buffer by removing C21. C17 was part of a voltage divider in the drive path to Q2. This was relocated to parallel C16, increasing the drive to the stage (see fig. 1).

We modified the oscillator by removing two capacitors which were in series with the crystal to ground and installed an MV2111 varicap in place of C13. A 47-k resistor connected to the junction of the crystal and the varicap provides the injection of the control voltage. We used a terminal normally used with the crystal oven as a connection point for the 47-k resistor and the incoming control signal.

Because we were operating the radios inside a heated ham shack, we didn't need the optional crystal ovens. However, you should use them in hilltop applications. In this case you need some other means of connecting to the 47-k resistor. (You can solder a terminal strip to the underside of the pc board near the oscillator circuit.)

Initial netting to the desired frequency must be done without the data connected to the modem board. If the voice option is available, just switch to voice; this will leave a carrier for setting the frequency. If you don't use a switch, disconnect (leave open) the data input.

The final modification involves bringing out the audio signal from the microphone preamp to the voice-data switch. Remove R21, the first resistor in the audio roll-off filter. (You may insert a wire in the now empty pad which connects to C9.) This picks up the signal at the deviation control. To get full deviation on voice, we raised the clipping level by changing R10 to a 3.3-k resistor.

Receiver module changes

The receiver modifications are made primarily to correct the group delay in the IF strip. We performed several tests to determine the necessity of changing both the 10.7-MHz crystal filters and the 455-kHz IF filter. We tried several combinations of crystal filters with very poor results. It's necessary to increase the 10.7-MHz IF bandwidth by replacing the crystal filters with a conventional FM broadcast-type IF ceramic filter. The original filter consists of four crystal filters (FL1 through FL4), so you must use a wire jumper to bridge across the three empty positions that remain. (See fig. 2.)

SATELLITE ESSENTIALS

Satellite TV is still full of the wonderment that made it so popular in the early '80s. The tinkerers are there, the programming is there, and never has the cost of becoming a dish owner been so low.

So, how do you find out about this exciting entertainment?

Through publications devoted specifically to satellite TV, that's how!

OnSat

America's Weekly Guide To Satellite TV

OnSat is unsurpassed for the most up-to-date listings of satellite programming. Dr. Dish, Mailbag, and the Transponder Service Watch are all geared to help you make the best use of your satellite TV system. A sample issue can be obtained for only \$1.

STV GUIDE

The Complete Monthly Guide To Satellite TV

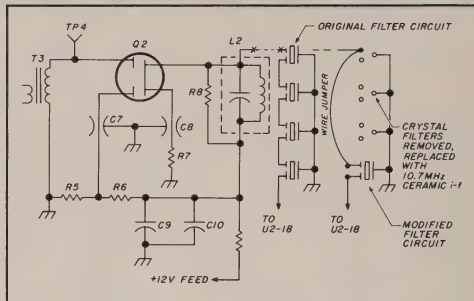
STV Guide contains over 300 pages of programming information, product reviews, home troubleshooting, and information about satellite TV. A sample issue can be obtained for only \$2.

Both OnSat and STV Guide contain listings for over 120 channels and Prime Time Grids for over 50 channels. Subscribe to either the weekly OnSat or the monthly STV Guide for only \$48 per year.

To start receiving the best in satellite TV guides and information, call toll-free (800) 234-0021. VISA® and MasterCard® accepted.

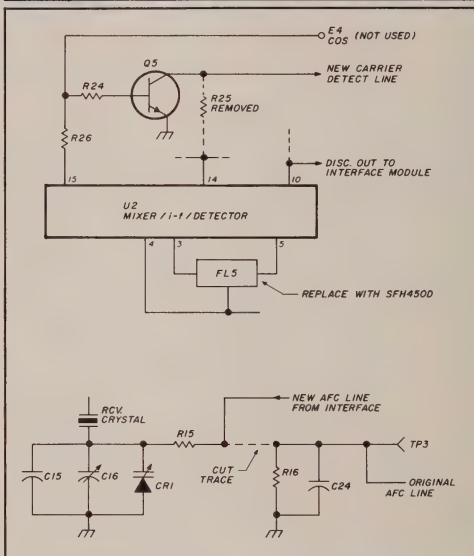
STV Guide/OnSat
PO Box 2384 • Shelby, NC 28151-2384

FIGURE 2



Partial schematic of 10.7-MHz filter change.

FIGURE 3



Partial schematic of receiver-module changes.

We replaced the 455-kHz second IF (FL5) with the Murata-Erie digital IF filter. This unit has a center frequency of 450 kHz instead of the conventional 455 kHz. We encountered no problems netting to frequency, because the 5-kHz difference was well within the "tweaking" range of the receive crystal trimmer. This filter fits the Hamtronics board with no modifications. (See fig. 3.)

Next, unsolder and lift the end of R15 at the junction with C24 and R16. This disables the normal AFC. Connect the "fast" AFC (terminal E6) from the modem board to the open end of R15. The direction of AFC action is right for centering an incoming signal. A wire

PLUG INTO PACKET!

Simple and Easy.

Here's the easiest packet radio yet, you don't even have to buy a TNC to join the digital revolution. Just let your PC do the work. Plug a PC Packet Adapter into any expansion slot and get on the air in minutes, just like an expert. And you'll still be able to use the PC for other work! The complete VHF system is only \$139.95!

Sophisticated, Too.

When you've mastered the basics, use the PC*Packet Adapter for simultaneous dual-band HF/VHF, multiconnect, BBS, TCP/IP, DXer's PacketCluster, 2400 baud (and higher). Even use the Developer's Package to write your own packet application.

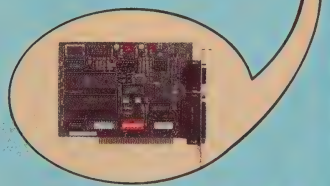
Software Included.

Unlike others, DRSI includes all the software you need. The THS terminal package has split screen, file save/send, binary file transfer, print, scroll, review and more.

2400 BAUD

Many areas are upgrading their packet nets to this higher speed. DRSI's M-24 modem for 2400 baud connects simply with no modifications to your rig and lets you operate both 1200 and 2400 simultaneously with your present radio. Step up to this new speed for just \$79.95, today!

Call or Write
for complete
Product Catalog



DRSI

2065 Range Road
Clearwater, FL 34625
ORDERS: 1-800-999-0204

✓ 132

QRZ CONTEST!™

VHF Contest Software
for PC Compatibles

- Now only \$19.95 postage paid
- Covers: ARRL Sprints, VHF QSO Parties, UHF, Jan. Sweepstakes, & the CQ World Wide VHF WPX
 - Menu driven and user friendly
 - Color and options user configured
 - Grids worked display on-line!
 - Full dupe checking & log editor
 - Full cursor cntrl. for data entry
 - Handles multi-op contest stations
 - Handles 4000 contacts with 256K
 - + HF version available Jan. 1989

ATFAB Computers and Electronics

P.O. Box 4766

Maineville, OH 45039

(513) 683-2042



Accepted

✓ 133

NEW! AZIMUTH WEATHER STAR

A Power-Packed Micro by DIGITAL
Weather Computer for Your Station...

Reads Wind Speed (MPH/KPH) • Hi Gusts • Wind Direction • Rainfall
Temperature (Present-Hi-Low) • Wind Chill • Scans All!



Protect Your Antenna & Home!

A must in every shack. Now you can scan... heavy Wind Gust... Wind Direction... Temp Hi/Low and more! Get your own computerized weather station at an incredibly low, affordable price.

The New Azimuth Weather Star by Digital is a high quality, power-packed weather computer, just loaded with features. Gives you accurate weather data... right in your shack... at the touch of a finger. Created with the latest CMOS micro-chip technology.

You Get All These Exciting FUNCTIONS & FEATURES with the TWR3

HANDY, COMPACT SIZE: 2 1/4" x 2 1/4" x 1 1/4"

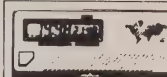
LARGE, EASY TO READ LCD READOUT Gives you Wind Speed • Records High Wind Gusts • Wind Direction • Wind Chill Factor • Outside Present Temperature (Remote sensor included) • Records High/Low Temperature • Reads in Fahrenheit, Celsius, Miles/Hour, or KM/Hr • Programmable Scan! • Operates on DC (Batteries Not Included) or AC with Optional adaptor • Rain Collector (Optional)

Your **TWR3 SYSTEM COMES COMPLETE WITH** • TWR3 Weather Computer • Anemometer & Wind Vane made of high impact, UV resistant plastic, with stainless bearings & shaft for years of trouble free service • 40 Feet of Cable lead-in with connectors • Outside Temperature Sensor • Clock & Mounting Hardware •



And it's **MADE IN AMERICA!** YOUR SATISFACTION GUARANTEED!
Or return in 10 days for a complete refund!

1 YEAR Limited WARRANTY from Manufacturer!



Your SPECIAL
FREE BONUS

Order TODAY!

Get the famous Azimuth World Time, Dual Zone 24-Hour Station Clock
Displays Local & Intl. in 15 Cities/Zones **Retail Value \$29.95**

ACT NOW! SEND TODAY!

AVAILABLE OPTIONS: Stainless Desk Stand (DSK22) @ \$9.95 • Rechargeable Ni-Cad Battery Pack (BP3) @ \$7.95 • 40 Ft. Extension Control Cable (EC40) @ 14.95 (Requires 2) • AC Power Adaptor (PS12) @ \$9.95 • Please add \$3.95 for Shipping & Handling of TWR3 • Rain Gauge (RG3) \$49.95 • For each option add \$1.00

CREDIT CARD ORDERS ONLY
CALL TOLL-FREE 1-800-882-7388 TODAY!
Or FAX Your Order 213-473-2325

Other Service Call 213-473-1332
(9AM to 6PM PST) Ca. Res. add sales tax



AZIMUTH WEATHER STAR

11845 W. Olympic Bl. Suite 1100, Los Angeles, CA 90064 USA (Dept. HR2)

AVAILABLE AT HENRY RADIO & ALL HAM RADIO OUTLETS!

✓ 134

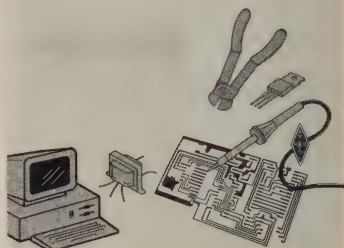
February 1989 **hr** 71

3 New Publications



HINTS AND KINKS for the RADIO AMATEUR

A collection of practical ideas gleaned from the pages of QST

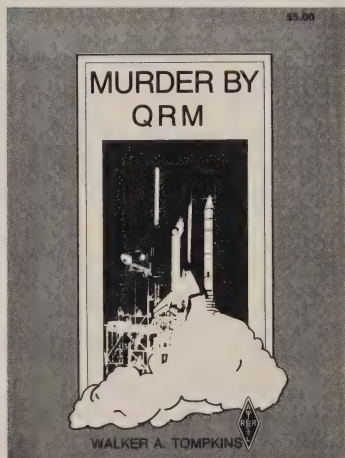


"A terrorist agent, representing an unknown foreign power or an internal subversive group, is bent on crippling or destroying America's space program by operating an illicit radio station from somewhere inside our Lost Padres National Forest wilderness area. A terrorist who has somehow gained access to our secret digital codes, launching schedules and classified radio frequencies required to cause our birds to self-destruct, during or after launch." And so begins a new adventure for Tommy Rockford, K6ATX.

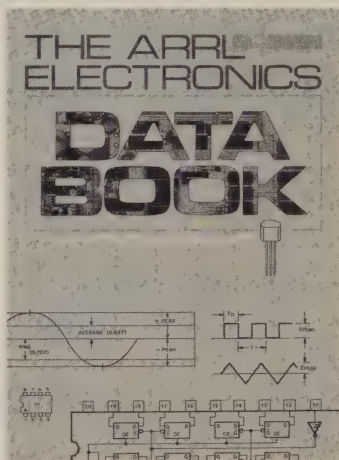
Murder by QRM is packed with action. Join K6ATX on an ill-fated search using motorized hang-gliders and then as he backpacks through the wilderness in search of the hidden transmitter site. With the launch of the space shuttle *Conquistador* only hours away will Tommy be able to ferret out the culprits before the fatal destruct signal is sent?

This is the sixth and final ham radio adventure by Walker Tompkins (the real K6ATX) who became a silent key just before the book was published. 194 pages, \$5.00*

*For postage and handling add \$2.50 (\$3.50 for insured parcel post or UPS—please specify)



The **ARRL Data Book** is back by popular demand! Doug DeMaw, W1FB has completely revised and expanded the material in this handy reference for the RF design engineer, technician, radio amateur, and experimenter. This *one* source has all of those regularly used tables, charts, and those hard-to-remember formulas. You'll also find hundreds of popular circuit diagrams of oscillators, mixers, amplifiers, other active devices and their operating



parameters. This book can be used alone or to complement **The ARRL Handbook** and belongs in every technical library. Here's a brief summary and chapter lineup: **Symbols, Conversion Factors and Tables; Components and Materials** includes color codes, standard values, toroid selection charts; **Inductors and Transformers; Time and Frequency Measurement; Networks and Filters** covers attenuators and matching network design information; **Digital Basics** is 88 pages of logic, TTL Circuits, specific device descriptions, linear ICs, op-amp applications, and regulators; **Antennas and Transmission Lines; Catalog of Circuit Building Blocks** including audio amps, RF and IF small-signal amplifiers, mixers, FM detectors, oscillators, dc switches and amps, and frequency doublers; **Workshop and Lab Practices**. 234 pages, \$12.00*

"Gimmicks and Gadgets, Tricks of the Trade." Since 1933, those words have been used to describe **Hints and Kinks for the Radio Amateur**, but it has been almost seven years since the last edition appeared. Well, H&K fans, the long wait is over. The 12th in the series of the most popular QST "Hints and Kinks" contributions is now available, and hams like yourself share their innovations and wizardry. Like its predecessors, this edition has been said to be almost like having a radio club meeting on your bookshelf!

Here's just a sample: **In and Around the Station:** A Universal Equipment Stand, Safe Power Wiring Practices, Stop the Fire, Not Your Gear. **Transmitting and Receiving:** A Two-Transistor Transmitter for 30 Meters, Improvements for the HW-8, FT101ZD, TS830S, SB200, and SB220. **CW Hints:** Magnetic Switch for CW Tune Up, The Sneaky Knee Key for Mobile CW. **Computers and Digital Modes:** A Message-Waiting Indicator for TNCs, Tips for the VIC 20, TRS80 and Apple II. **Antennas and Feedlines:** Inexpensive 30 and 12-Meter Arrays, Retuning Traps for the WARC Bands, Baluns, Tower and Rotator Tips. **Shop Secrets:** Tips on soldering and making PC Boards and more! **Tips on Testing:** Simple Logic Probe, plus 11 pages of test equipment and tips. **Portable and Mobile:** Power supplies, antennas, mobile installation tips. **VHF and UHF:** Antennas, amplifiers, CTCSS Tone Generator and more. **Power Supplies:** Power Supplies from Old Battery Chargers, High-Voltage Supply for Mobile Amplifiers. **Taming Interference:** Telephone RFI, TVI, CATV cures. **Miscellaneous:** COR and Timer Circuit, World-Time-Finder Slide Rule, AFSK System for FAX and more. 160 pages, \$5.00*

WIN A BILL ORR Handbook

Here's how.

Please fill out the Magazine evaluation card and mail it to us. We'll tabulate all the responses to see what you do and do not like.

There will be a drawing of evaluation cards. The person whose card is picked will win an Orr Handbook. Help us make the best Amateur magazine even better.

Also, each month the author of the most popular WEEKENDER will also be given a Bill Orr Handbook.

HAM RADIO

MAGAZINE EVALUATION & SWEEPS ENTRY CARD

Here's YOUR chance to comment on this issue of HR and enter our monthly radio drawing. Carefully read all the articles in this issue. Then, rate each article in this issue. Also let us know what you think of our changes to the magazine. Each article is marked with a letter on the last page.

Article	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
I LIKE IT																				
OK																				
SORRY, NO.																				

MAGAZINE OVERALL GOOD _____ OK _____ NOT SO GOOD _____ I like the ☐ Old ☐ New HR Better

NAME _____ Class _____ License _____ Age _____

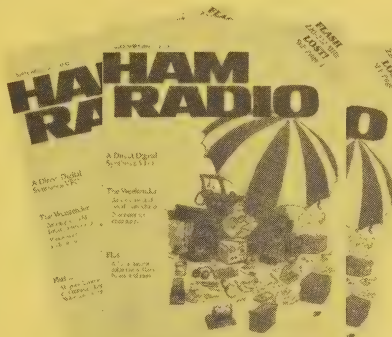
ADDRESS _____

CITY _____ STATE _____ ZIP _____

Please run more: _____

Please run less: _____

FEB. 89



- ☐ One year 12 issues \$22.95
☐ Two years 24 issues \$38.95
☐ Three years 36 issues \$49.95

Subscribe to HAM RADIO today. Tap into Amateur Radio's #1 technical and building journal. You'll also save \$7.05 off the newsstand price (\$30 per year)! Fill out this card and mail it in.

For even more prompt service, call TOLL FREE (800) 341-1522, MasterCard, VISA and Bill Me orders accepted. Phone lines open Monday thru Friday 8 a.m. to 9 p.m. Please, orders only.

☐ Bill me ☐ Payment enclosed

Name _____

Address _____

City _____ State _____

☐ Check if this is a renewal FEB. 89

Please allow 4-6 weeks for delivery of first issue.

FOREIGN RATES: Europe via Air Forwarding Service \$40 per year. All other countries \$31.00 per year.

HAM RADIO Reader Service

101 113 125 137 149 161 173 185 197 209 221 233 245 257 269 281 293 305 317 329 341
 102 114 126 138 150 162 174 186 198 210 222 234 246 258 270 282 294 306 318 330 342
 103 115 127 139 151 163 175 187 199 211 223 235 247 259 271 283 295 307 319 331 343
 104 116 128 140 152 164 176 188 200 212 224 236 248 260 272 284 296 308 320 332 344
 105 117 129 141 153 165 177 189 201 213 225 237 249 261 273 285 297 309 321 333 345
 106 118 130 142 154 166 178 190 202 214 226 238 250 262 274 286 298 310 322 334 346
 107 119 131 143 155 167 179 191 203 215 227 239 251 263 275 287 299 311 323 335 347
 108 120 132 144 156 168 180 192 204 216 228 240 252 264 276 288 300 312 324 336 348
 109 121 133 145 157 169 181 193 205 217 229 241 253 265 277 289 301 313 325 337 349
 110 122 134 146 158 170 182 194 206 218 230 242 254 266 278 290 302 314 326 338 350
 111 123 135 147 159 171 183 195 207 219 231 243 255 267 279 291 303 315 327 339
 112 124 136 148 160 172 184 196 208 220 232 244 256 268 280 292 304 316 328 340

For FREE literature or more information, first locate the company number at the bottom of the ad. Circle the appropriate number on this card, affix postage and drop into the mail. We'll hustle your request off to the companies you are interested in!

NAME _____ CALL _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

PLEASE USE BEFORE APRIL 30, 1989

FEBRUARY 1989

AFFIX POSTAGE
OR
POST OFFICE
WILL NOT
DELIVER

HAM RADIO

MAIN STREET
GREENVILLE, N.H. 03048

Please
enter my
subscription



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY CARD

First Class Permit No. 1 Greenville, NH

Postage Will Be Paid By Addressee

HAM RADIO

Greenville, NH 03048

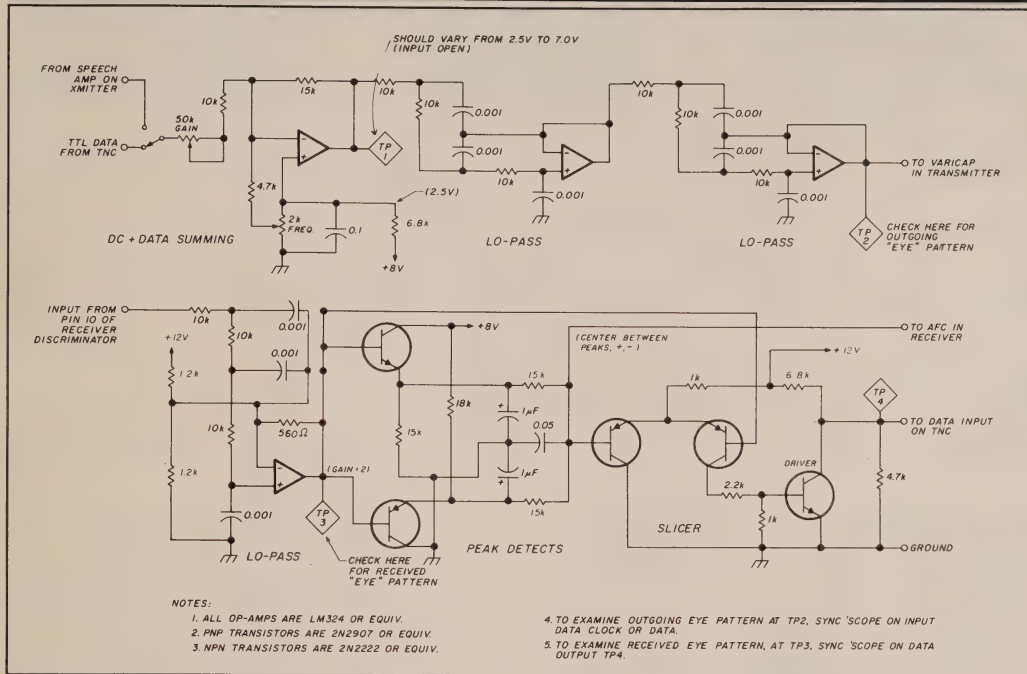
AFFIX POSTAGE
OR
POST OFFICE
WILL NOT
DELIVER

HAM RADIO

READER SERVICE CENTER
P.O. BOX 2558
WOBURN, MASS. 01888

ATTN: Reader Service Dept.

FIGURE 4



Schematic of 9600-baud packet radio interface.

from pin 10 of the discriminator (U2) brings the FM output to the modem board, terminal E4.

Finally, remove R25 in the squelch circuit. This leaves the collector of Q5 open. Connect a wire from the collector to the squelch input of the TNC. This will operate the carrier detect light on the TNC and hold back transmission when the channel is busy.

The various receiver connections won't inhibit normal receiver use for either data or voice. The squelch action will, however, be "softer" because there's no longer any hysteresis in the detector.

Modem board

Figure 4 is a schematic diagram of the modem or interface between the TNC and the radio. As you'd expect, there are two distinct sections — the transmit encoder and the receive decoder.

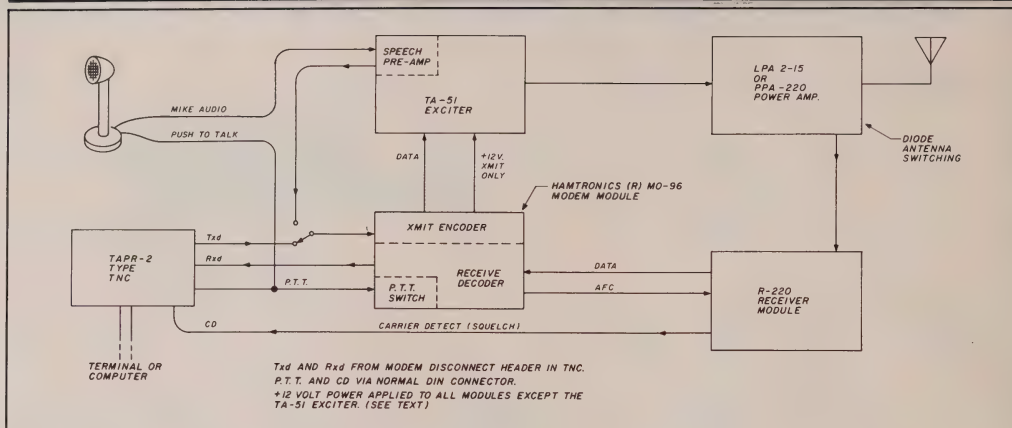
The transmit section uses three sections of a quad op amp, (LM-324). The first stage combines the data or optional voice signal with the DC offset voltage. Varying the frequency adjust pot setting shifts the bias or center value of the output voltage. This then establishes the carrier center frequency. The fixed voltage at the noninverting input is +2.5 volts; when data is

applied (5-volt logic levels) it will shift the output of the op amp equally above and below the desired output point. This causes an equal carrier shift above and below the center frequency.

The signal at TP1 is still a square wave, so two stages of active low-pass filtering follow. After filtering, the output at TP2 will be nearly sinusoidal in shape. This reduces the bandwidth of the transmitted signal. The DC level injected at the first stage is unaffected by the filters and also serves as the filter bias. The signal at the output is next applied to the varicap in the transmitter circuit, through a series resistor. The nominal voltage at TP2 will be about 5-6 volts with ± 2 volts deviation when data is present.

The receive section is a bit more complex. The output of the receiver discriminator is first applied to another filter similar in function to those used in the transmit section. The intent is to reduce the bandwidth of the received audio, removing high-frequency noise which would interfere with data decoding. A gain-adjusting resistor is added to the network to boost the signal level by a factor of 2. This raises the low signal level from the discriminator output to improve the operation of the level detectors.

FIGURE 5



Block diagram of complete packet radio system.

Two transistors are used as peak level detectors. The NPN "follows" the positive excursions of the signal, charging up the 1- μ F capacitor to near the peak positive value. In like manner, the PNP follows the negative peaks, charging another 1- μ F capacitor. The discharge time constant is equal to about 20 bit periods at 9600 baud. A pair of equal (15 k) resistors bridges the two level detectors. The voltage at the center tap of the resistors is the value of the midpoint between the two peaks.

This voltage serves two purposes. Because it has a very fast attack and represents the center of the modulation swings, it can be applied to the AFC circuit in the R-220. This helps the receiver to center rapidly on an incoming signal during the preamble or "flags" period.

The voltage is also used as a reference voltage applied to one input of a differential comparator or "slicer," using two PNP transistors. With the reference applied to one input and the raw data signal applied to the other, the resulting output is a digital representation of the instantaneous received signal frequency. The signal is buffered and shaped to TTL logic level by the NPN transistor and the resistive voltage divider. Note that this isn't an RS-232 signal, but a logic level to be applied to the external modem connector of the TNC.

System interconnections

Figure 5 is a block diagram of the complete system showing the Hamtronics modules, the interface or modem board, and the interconnections to the TNC. The TNC must have a modem disconnect header or

connector. It must also be set for 9600-baud operation. The RS-232 port from the TNC isn't shown; it may be operated at whatever data rate you desire.

Twelve-volt power is applied to all of the modules except the exciter. Because the power amplifier module is class C, it isn't necessary to switch the power — only the drive. When the TNC pulls down on the PTT line, the transistor switch on the modem board applies the 12 volts to the exciter. This drives the power amplifier into conduction, drawing current from the 12-volt supply, which in turn operates the diode antenna switch.

The receiver module is powered at all times. When you transmit, your signal will be received, decoded, and passed back to your TNC. This permits a built-in "loopback test" function. Depending on the cable layout and the isolation of the T/R diode switching, you may have enough overload on the receiver to prevent clean reception of your own signal. Usually a good match to the antenna, decent cable connections, and grounding of all modules will tame any overload.

We brought the microphone preamp on the Hamtronics TA-51 exciter out to a switch and wired it to select either data or voice signal. The push-to-talk switch on the mike is wired in parallel with the PTT line from the TNC. This provides a voice mode which we used as an "intercom" during testing. This may even be helpful in a remote backbone digipeater situation, for use during setup and maintenance visits.

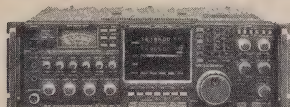
Summary — where do we go from here?

In the year that our on-the-air testing has been in

ICOM

KENWOOD

YAESU



IC-781

HF Equipment	List	Juns
IC-781 New Deluxe HF Rig	\$5995.00	Call \$
IC-761 Loaded With Extras	2699.00	Call \$
IC-735 Gen. Cvg Xcvr	1099.00	Call \$
IC-751A Gen. Cvg Xcvr	1699.00	Call \$
IC-575A 10m/6m Xcvr	1399.00	Call \$

Receivers	List	Juns
IC-R7000 25-1300 + MHz Rcvr	1199.00	Call \$
IC-R71A 100 kHz-30 MHz Rcvr	999.00	Call \$

VHF	List	Juns
IC-228A New 25w Mobile	509.00	Call \$
IC-228H New 45w Mobile	539.00	Call \$
IC-275A All Mode Base w/PS	1299.00	Call \$
IC-275H All Mode Base 100w	1399.00	Call \$
IC-28A FM Mobile 25w	469.00	Call \$
IC-28H FM Mobile 45w	499.00	Call \$
IC-2GAT, New 7w HT	429.95	Call \$
IC-02AT FM HT, HP	409.00	Call \$
IC-900 Six Band Mobile	639.00	Call \$

UHF	List	Juns
IC-475A All Mode 25w	1399.00	Call \$
IC-475H All Mode 75w	1599.00	Call \$
IC-48A FM Mobile 25w	509.00	Call \$
IC-4GAT, New 6w HT	449.95	Call \$
IC-4AT FM HT	349.00	Call \$
IC-04AT FM HT	449.00	Call \$
IC-448A, 25w Mobile	TBA	Call \$
IC-3200A FM 2m/70cm 25w	649.00	Call \$
IC-32AT Dual Band Handheld	629.95	Call \$
IC-3210 Dual Band Mobile	TBA	Call \$

220 MHz	List	Juns
IC-375A All-Mode, 25w, Base Sta.	1399.00	Call \$
IC-38A 25w FM Xcvr	489.00	Call \$
IC-37A FM Mobile 25w	499.00	Call \$
IC-3AT FM HT	349.00	Call \$
IC-03AT Deluxe HT	449.00	Call \$

1.2 GHz	List	Juns
IC-1271A All Mode 10w	1269.00	Call \$
IC-1200 FM, 10w Mobile	699.00	Call \$
IC-12AT Deluxe 1w HT	473.00	Call \$



TS-940S

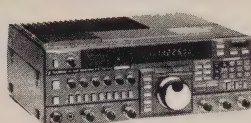
HF Equipment	List	Juns
TS-940S/AT Gen. Cvg Xcvr	\$2499.95	Call \$
TS-440S/AT Gen. Cvg Xcvr	1449.95	Call \$
TS-140S Compact, Gen. Cvg Xcvr	949.95	Call \$
TS-680S HF Plus 6m Xcvr	1149.95	Call \$
TL-922A HF Amp	1649.95	Call \$

Receivers	List	Juns
R-5000 100 kHz-30 MHz	1049.95	Call \$
R-2000 150 kHz-30 MHz	799.95	Call \$
RZ-1 Compact Scanning Rcvr.	599.95	Call \$

VHF	List	Juns
TS-711A All Mode Base 25w	1059.95	Call \$
TR-751A All Mode Mobile 25w	969.95	Call \$
TM-221A Compact FM 45w	459.95	Call \$
TM-2530A FM Mobile 25w	499.95	Call \$
TM-2550A FM Mobile 45w	519.95	Call \$
TM-2570A FM Mobile 70w	623.95	Call \$
TH-215A, 2m HT Has It All	399.95	Call \$
TH-25AT 5w Pocket HT NEW	369.95	Call \$
TM-721A 2m/70cm, FM, Mobile	729.95	Call \$
TM-621 2m/220, FM, Mobile	699.95	Call \$

UHF	List	Juns
TS-811A All Mode Base 25w	1,265.95	Call \$
TR-851A 25w SSB/FM	771.95	Call \$
TM-421A Compact FM 35w	469.95	Call \$
TH-415A 2.5w 440 HT	419.95	Call \$
TH-45AT 5w Pocket HT NEW	389.95	Call \$
TW-4100A, 2m/70cm FM	599.95	Call \$
TH-55 AT 1.2 GHz HT	524.95	Call \$
TR-50 1w 1.2GHz FM	629.95	Call \$

220 MHz	List	Juns
TM-3530A FM 220 MHz 25w	519.95	Call \$
TH-31BT FM, 220 MHz HT	299.95	Call \$
TM-321A Compact 25w Mobile	469.95	Call \$
TH-315A Full Featured 2.5w HT	419.95	Call \$



FT-767GX

HF Equipment	List	Juns
FT-747 GX New Economical Performer	\$889.95	Call \$
FT-757 GX II Gen. Cvg Xcvr	1129.95	Call \$
FT-767 4 Band New	1929.00	Call \$
FL-7000 15m-160m Solid State Amp	1995.00	Call \$

Receivers	List	Juns
FRG-8800 150 kHz - 30 MHz	759.95	Call \$
FRG-9600 60-905 MHz	699.95	Call \$

VHF	List	Juns
FT-411 New 2m "Loaded" HT	TBA	Call \$
FT-212RH New 2m, 45w mobile	459.95	Call \$
FT-211 RH 2m, 45w, FM	459.95	Call \$
FT-290R All Mode Portable	599.95	Call \$
FT-23 R/T Mini HT	344.95	Call \$

UHF	List	Juns
FT-712RH, 70cm, 35w mobile	499.95	Call \$
FT-711RH FM Mobile 35w	449.95	Call \$
FT-73 R/T Mini HT	349.95	Call \$
FT-709RH FM HT 4w	389.95	Call \$
FT-790R MKII FM/SSB, 25w	799.95	Call \$
FT-2311R 10w, 1.2 GHz, FM	559.95	Call \$

VHF/UHF Full Duplex	List	Juns
FT-736R, New All Mode, 2m/70cm	1749.95	Call \$
FEX-736-50 6m, 10w Module	259.95	Call \$
FEX-736-220 220 MHz, 25w Module	279.95	Call \$
FEX-736-1.2 1.2 GHz, 10w Module	539.95	Call \$
FT-690R MKII, 6m, All Mode, port.	569.95	Call \$

Dual Bander	List	Juns
FT-727R 2m/70 cm HT	439.95	Call \$
FT-4700RH, 2m/440 Mobile	TBA	Call \$

220 MHz	List	Juns
FT-33R, mini HT	389.95	Call \$
FT-109 RH New HT	399.95	Call \$
FT-312 RM, Mobile	TBA	Call \$
FT-311 RM Mobile	499.95	Call \$

Repeaters	List	Juns
FTR-2410 2m Repeaters	1269.95	Call \$
FTR-5410 70cm Repeaters	1289.95	Call \$

JUN'S ELECTRONICS

800-882-1343



JUN'S BARGAIN BOX

OVERSTOCK SALE LIMITED QUANTITIES

ICOM	YAESU	KENWOOD
IC-03AT now \$269.95	FT-727R only \$359.95	TH-31BT SPECIAL
IC-3200A now \$479.95	FT109RH only \$239.95	TH-315A SALE
IC-04AT now \$369.95	FT-311RM only \$239.95	TM-321A PRICES
IC-4AT now \$259.95		TW-4100A

• AMATEUR • TWO WAY • MARINE • SE HABLE ESPANOL
• Free U.P.S. Cash Order • (Most Items, Most Places)

(213)390-8003 3919 Sepulveda Blvd. Culver City, CA 90230

"ONLINE" U.S. CALL DIRECTORY

Hamcall service gives you all hams via your computer & modem. Updated each month! Only \$29.95 per year. Unlimited use - you pay for phone call.

BUCKMASTER PUBLISHING

Route 3, Box 56
Mineral, Virginia 23117
703/894-5777 visa/mc 800/282-5628

THE **ISOTRON**
COMPACT ANTENNAS FROM 160-10 METERS

NO TUNERS!
NO RADIALS!
NO RESISTORS!
NO COMPROMISE!
THREE EXCELLENT REVIEWS JUST
DON'T HAPPEN BY CHANCE.
CALL US FOR A FREE CATALOGUE.

*See review in Oct 73, 1984
*Sept 73, 1985 *March 73, 1986

NEW LOCATION!
BILAL COMPANY
137 Manchester Dr.
Florissant, Colo. 80816
(719) 687-0650

CADDELL COIL CORP.

35 Main Street
Poultney, VT 05764
802-287-4055

BALUNS

Get POWER to your antenna! Our Baluns are already wound and ready for installation in your transmatch or you may enclose them in a weatherproof box and connect them directly at the antenna. They are designed for 3-30 MHz operation. (See ARRL Handbook pages 19-9 or 6-20 for construction details.)

100 Watt (4:1, 6:1, 9:1, or 1:1 Impedance—select one)	\$10.50
Universal Transmatch 1 KW (4:1 Impedance)	14.50
Universal Transmatch 2 KW (4:1 Impedance)	17.00
Universal Transmatch 1 KW (6:1, 9:1, or 1:1—select one)	16.00
Universal Transmatch 2 KW (6:1, 9:1, or 1:1—select one)	18.50

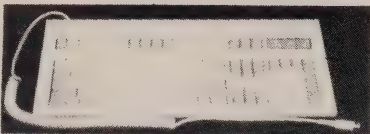
Please send large SASE for info.

John J. Meshna Jr., Inc.

SURPLUS ELECTRONICS

IBM® Compatible Enhanced Keyboard

A major U.S. Keyboard manufacturer recently released has excess inventory of IBM® Compatible PC, XT, & AT 101 key Keyboards. We are prohibited from advertising the manufacturers name, but with just a look you will know who made these high quality keyboards. These boards are D.I.P. switch selectable for either IBM® PC, XT, & AT compatible computers and clones. There are retractable feet on the bottom of the case. Most are in their original boxes. Each one sold will include a schematic. Guaranteed OK.
Shpg. Wt. 4 Lbs. KYBD-11-51 \$39.00 each. 3/\$115.00



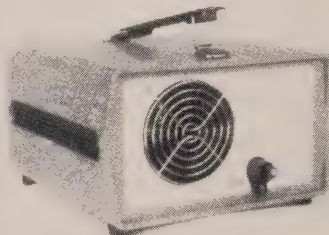
MILITARY M-80/U MICROPHONES



We have another sample of our tax dollars at work. Uncle Sam has recently released these very high quality, weatherproof, push to talk, dynamic microphones. Each one has a coil cord that can stretch out 10 feet. For extended life of the cord a spring strain relief is standard. A U229/U connector contains 5 gold plated pins to insure a high integrity electrical connection. We provide you with a schematic of the microphone so that you can rewire them for marine radio use. The were originally made for use with the PRC-25 and the PRC-77 transceivers. Used, good condition.
Shpg. Wt. 2 Lbs...SPL-10-51...\$8.00 each.

PARTS GALORE ASSEMBLY

Pictured below is a high reliability power supply. It contains many very useful and expensive parts. We must offer these parts to you individually because, due to the agreement with the manufacturer we can not sell the unit intact.



POWER SUPPLY REGULATOR BOARD

Consists of LM 123 IC regulator or equivalent, TIP 32 transistor, 6 amp bridge, 10,000 uf, 50V capacitor, LM 340T12 regulator, a star 6V buzzer, 2 sockets to hold the smaller 2 bands which consist of LM 39N IC, reg, TIP 32 X-ister, 4-10K 10-turn Pots, tantalums, and loads of other parts.

Shpg. Wt. 2.5 Lbs. SP-274B-51 \$3.50

TRANSFORMER made by Signal or Aerospace Systems. Input: 110/220VAC, Output: 24v, 3a; 10v, 3a.

Shpg. Wt. 3 Lbs. T-661-51 \$5.00

DUAL POWER TRANSISTORS ASSEMBLY

2N6249 or equivalent high power switching X-isters rated at 300VCBO 30 amps, 175 watts silicon NPN which list for over \$8.00 each, mounted in an aluminum housing in sockets.

Shpg. Wt. 0.5 Lbs. SP-276B-51 \$1.75

FAN similar in size and speed to IMC Slim Mini Boxer, 115VAC, 50/60Hz, 30 CFM.

Shpg. Wt. 1 Lb. SP-231A-51 \$3.75

Finger Guard for above, Zink Plated.

Shpg. Wt. 0.5 Lbs. SP-369D \$0.50

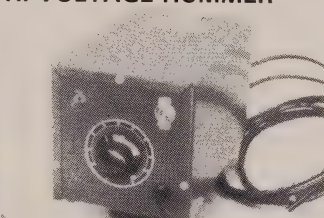
CORD for above fan.

Shpg. Wt. 0.2 Lbs. SP-275EG \$0.35

CASE aluminum chassis rubber feet and carrying handle. 9½x5½x9¼"

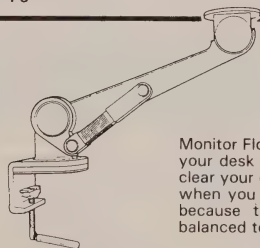
Shpg. Wt. 2 Lbs. SPL-107-51 \$7.50

HI VOLTAGE HUMMER



ZZZIP, ZZZIP It's time to make a Jacobs Ladder or some other hi-voltage device. One of our bird dogs recently found us a few of these adjustable hi-voltage power supplies. The output is 4 kilovolts AC, 75mA. Each one is fully enclosed and comes with 4.5 feet of hi-voltage wire. The wire terminates in a molded connector. A solid state variac adjusts the output voltage from 0 to 4k VAC @ 75 mA. The front panel has a toggle switch, a red pilot light and the adjustment knob. The power supplies are fully enclosed by a black or blue aluminum case. Made by Aristo. We hunted to find a compatible device and found they sell it for as much as \$850.00! **CAUTION!** This device uses lethal voltages and care must be taken when using it. We take no responsibility for your actions. New Condition.

Shpg. Wt. 12 Lbs PS-25B-51 \$50.00



MONITOR FLOAT ARM

Monitor Float Arm is the easiest way to keep your monitor off your desk yet within reach. Just push your monitor aside to clear your desk...Swing it over to the proper working position when you want to use it. It can all be down with one hand because the Float Arm is pneumatically controlled and balanced to effortlessly float your monitor where you want it.

Use it with any monitor. The arm adjusts vertically, and will accommodate monitors weighing up to 35 lbs. It rotates 90 degrees to the left or right along a 14" radius and arm floats. The unit has a universal 4" diameter mounting plate with a 3" dia bolt circle of 4 holes. We recommend you make a mounting plate of 1/2" thick plywood of a size to fit the

base of your monitor, and bolt it to the Monitor Float Arm, then place your monitor on top. It was designed to hold a 14" color monitor for a big name computer manufacturer, and you can buy it at a small fraction of cost.

Shpg. Wt. 10 Lbs. SPL-322-51 \$29.95
4 for \$100.00

John J. Meshna Jr., Inc. SURPLUS ELECTRONICS

19 Allerton St. P.O. Box 8062 E. Lynn, MA 01940 Tel. (617)595-2275 FAX. (617)595-4680
Phone Orders accepted on MC, VISA, Diners Club, or American Express, \$20.00 minimum order.

progress, there has been little published on the topic of higher speed packet operation. Everyone seems to be waiting to see what sort of equipment will emerge as the de facto standard. It seems that no one wants to be the first kid on the block to jump in. There are a few group efforts under way, but little information of a solid technical nature has appeared to let us know what's going on.

The system we've described here is a "Minimum Shift, Bandwidth Limited, Frequency Modulation System." Although I have not contacted AEA or GLB, an examination of their spec sheets indicates use of a very similar modulation method. The data rate is higher, so the bandwidth is wider but still in the same general relationship.

Naturally, each designer begins with a set of assumptions and builds from there. We assumed 9600 baud, since a standard (unmodified) TAPR-2 TNC will run only that fast. It can be pushed up by altering the taps on the clock divider, but we felt 9600 baud without cutting into the TNC would be attractive to most hams.

We arbitrarily chose a bandwidth of 8-10 kHz as a compromise. It's approximately the lower limit of Shannon's rule of thumb (1 Hz/bit/sec of bandwidth) and at reasonable "Amateur" signal-to-noise ratios. We also considered the availability of the Murata-Erie IF filters. Because the signal isn't crowded into a very narrow filter, phase distortion isn't a serious problem and frequency stability is less critical. In a year of operation, we haven't had to adjust the frequency of either unit.

We also considered the inclusion of a data "scrambler/descrambler" to reduce the DC content of the data signal. This lessens the tendency of the level detector or slicer to shift during periods of DC unbalance. In testing, the bit stuffing done by the TNC appeared to be adequate to survive even deliberate long strings of null characters or FFs in transparent mode. If you're a purist, you can still add a shift register scrambler in the data lines at each end of the circuit.

The standards we chose are loose enough to permit some latitude in matching to other system standards, within reasonable limits. We'd like to have an opportunity to see if our system is truly compatible with a GLB or AEA running at 9600 baud and with some similarity in the deviation. It should fly, but we won't know until we have a chance at one.

Just as I was finishing this article, I received the May 27th issue of the *Gateway*, volume 4, no. 18. It contains the specifications for the 9600-baud modem project, designed by James Miller, G3RUH. I was most interested in comparing the standards he used with the standards we have described. It appears that the

approach is very similar. The major difference is that we have a "cheapie" version — sort of a Model T compared to a Cadillac.

The modulation scheme is identical. Direct FM is applied to a varactor diode. Miller shaves the deviation a little tighter, using 3-kHz deviation as opposed to the 4 kHz we used. The bandwidth low-pass filtering is done with a very classy digital "finite impulse response" transversal filter. While it's very sharp on the sides, the cut-off frequency is also 4800 Hz. He also included a shift register scrambler to remove any long strings of zeros or ones. Another interesting difference is the use of precompensation (or predistortion in the opposite direction), to correct the system phase distortion at the transmitter instead of the receiver.

Up to this point, the differences are quite minimal. The major difference seems to be in the complexity of the respective systems. I certainly agree that the super high-quality filters and digital PLL clock detectors can do nothing but improve performance. Our intent was to break some fresh ground and get some action started in 9600-baud networking. It will be interesting to check out our system in real over-the-air tests with the G3RUH modem. From the standpoint of compatibility, they should get along fine together.

Naturally, it's our hope that some packeteers in our area, or our neighbors in Canada, might try some tests with us. We've passed thousands of bytes of data back and forth, but it sure would be nice to do more than tests!

In conclusion, we want to thank Jerry Vogt, WA2GCF, of Hamtronics for his help on the modifications to the transceivers and for making pc boards available. Murata-Erie was also helpful in supplying several different filters, permitting a choice of the best bandwidth for this data rate.

The following modules are available from Hamtronics, Inc., 65 Moul Road, Hilton, New York 14468-9535, (716)392-9430.

MO-96 Packet Radio Networking Modem Module

TA-51-220-HS High-speed Data Exciter Module

R-220-HS High-speed Data Receiver Module

LPA 2-15 (220) 15-watt PA Module with diode antenna switch

PPA-220 50-watt Packet PA Module with pin diode antenna switch

Appendix A

Layman's (simplified) guide to data transmission

The following is admittedly not technically correct, but is presented to help you understand the basic methods used in transmitting data on VHF radio. Sig-

nal preparation will be shown up to the point of application to the FM modulator, and then as received from an FM discriminator or PLL detector.

If a random data signal is displayed on a scope and triggered at the bit rate, successive sweeps will overlap, creating what is known as an "eye" pattern. This pattern serves as a means of estimating the quality of the transmission/reception system, or path.

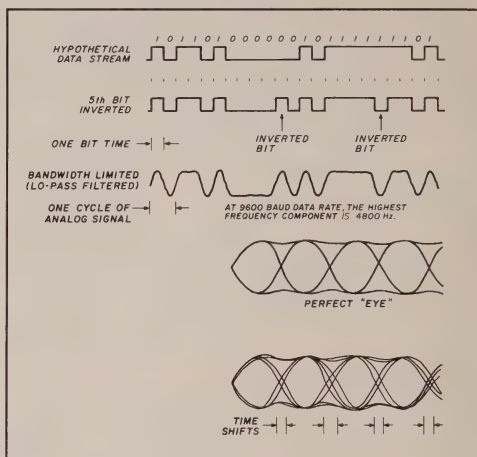
To determine whether a signal represents a "one" or a "zero," you must make a decision at a time interval related to past zero crossings. The absence or presence of zero crossings at the bit intervals indicates a change of the digital state. There are other more sophisticated methods for making the decision, but zero crossings are commonly used. Whatever method you use, the time between changes of state will always affect the error rate. "Jitter," or random time variations, make it more difficult to decode the data accurately.

If a signal is corrupted by noise, both the levels and the zero crossing times will be affected.

Even when the signal is not noisy, phase distortion or delay will alter the zero crossing times. This also causes errors in the data. This effect is caused by differences in the time delays of the different frequency components of the signal as they pass through filters, like the IF filters in the radio. This also is known as "Envelope Group Delay," or "Group Delay Time."

Conclusions

1. To send digital data at high speed over radio links, you must pay attention to signal quality (noise, distortion, and phase shift) in the communications channel.



2. A rule of thumb for FM is that the signal deviation should be about half the data bit rate. Another way to state this is: "The bandwidth is about equal to the data rate," since the channel bandwidth is twice the deviation.

3. The digital data must not have strong DC components. Either "bit stuffing" or a "shift register scrambler" should be used to prevent long strings of zero or one bits.

4. The receiver bandwidth should be reasonably matched to the signal bandwidth for best signal-to-noise ratio and lowest error rate.

Article H

HAM RADIO

BLACK DACRON® POLYESTER ANTENNA ROPE

- UV-PROTECTED
- HIGH ABRASION RESISTANCE
- REQUIRES NO EXPENSIVE POTTING HEADS
- EASY TO TIE & UNTIE KNOTS
- EASY TO CUT WITH OUR HOT KNIFE
- SIZES: 3/32" 3/16" 5/16"
- SATISFIED CUSTOMERS DECLARE EXCELLENCE THROUGHOUT U.S.A.

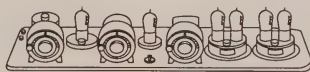
LET US INTRODUCE OUR DACRON® ROPE TO YOU • SEND YOUR NAME AND ADDRESS AND WE'LL SEND YOU FREE SAMPLES OF EACH SIZE AND COMPLETE ORDERING INFORMATION.

Dealer Inquiries Invited



MANUFACTURED BY
synthetic
textiles, inc. 2472 EASTMAN AVE., BUILDING 21
VENTURA, CALIFORNIA 93003
(805) 658-7903

REGISTERED U.S. PATENT & TRADEMARK OFFICE



IF YOU BUY, SELL OR COLLECT
OLD RADIOS, YOU NEED...

ANTIQUE RADIO CLASSIFIED

Antique Radio's
Largest-Circulation
Monthly Magazine



FREE SAMPLE COPY!

Classifieds - Ads for Parts & Services
Articles - Auction Prices-Flea Market Info.
Also: Early TV, Ham Equip., Books, Telegraph,
Art Deco, 40's & 50's Radios & more...
Free 20-word ad each month. Don't miss out!

6-Month Trial - \$11.

1-Year: \$19 (\$28 by 1st Class)

Foreign by air - Canada: \$30; Mexico: \$28; Other: \$55.

A.R.C., P.O. Box 2-A4, Carlisle, MA 01741

Electronic Repair Center

Servicing

Amateur

Commercial Radio

The most complete repair facility on
the East Coast.

Large parts inventory and factory
authorized warranty service for
Kenwood, Icom and Yaesu.

SEND US YOUR PROBLEMS

Servicing "Hams" for 30 years, no rig
too old or new for us.

HAMTRONICS, INC.

4033 Brownsville Road
Trevose, Pa. 19047

215-357-1400





PRACTICALLY SPEAKING

Joe Carr, K4IPV

Antenna system instruments

One of the perennial topics addressed by Amateur Radio articles is the instrumentation needed for antenna systems. This isn't because there's nothing else to write about, but because readers continually request information about things like impedance bridges, noise bridges, and dip oscillators. There are more sophisticated instruments available, but these few are all most of us need for our antenna testing requirements.

There are two main things to worry about when designing and installing Amateur Radio antenna systems. First, you need to know the frequency on which the antenna is resonant (hopefully, inside an Amateur band). Second, you need to know the feedpoint

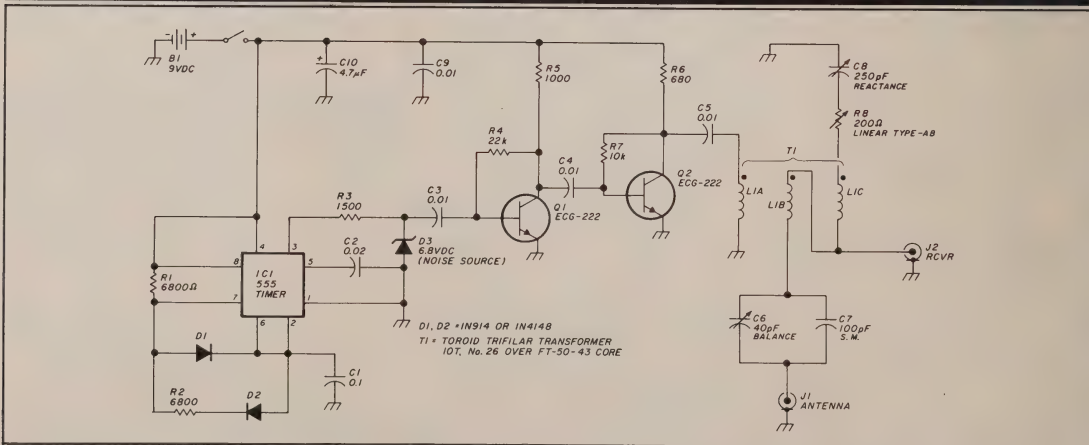
impedance, to make impedance matching easier (or, for that matter, possible). Let's take a look at some impedance bridges: noise types, VSWR bridges, and dip oscillators. There are more sophisticated instruments available, but these few are all most of us need for our antenna testing requirements.

The RF noise bridge

The RF noise bridge is a device that was once associated only with engineering laboratories, but it has Amateur Radio applications as well. Amateurs have been using noise bridges for many years, although at one time most of them were homebrew. The noise bridge is one of the most useful, low-cost, and often overlooked test instruments available.

Several companies have produced low-cost noise bridges: Omega-T, Palomar Engineers, and most recently, the Heath Company. The Omega-T and the Palomar Engineers models are shown in **photos A and B**. The Omega-T device (**photo A**) is a small cube with one dial and a pair of BNC coax connectors (ANTENNA and RECEIVER). The dial is calibrated in ohms and measures the resistive component of impedance only. The Palomar Engineers device does everything the Omega-T does. It also lets you make a rough measurement of the reactive component of impedance. The Heath Company added their Model HD-1422 to the line-up; it's a "one-evening" kit. I reviewed the HD-1422 in my May 1986 column, so I won't elaborate on it here.

FIGURE 1



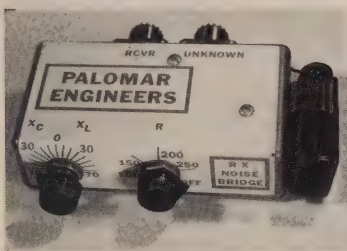
Noise bridge circuit.

PHOTO A



Omega-T noise bridge.

PHOTO B



Palomar Engineers noise bridge.

Over the years, some people have found the noise bridge useful for a variety of test and measurement applications — especially in the HF and low VHF regions. Its applications are not limited to antenna testing (the main job of the noise bridge). The two-way technician or Amateur Radio operator may use the device to measure antennas, tested circuits, and resonant cavities.

Figure 1 shows a noise bridge circuit. The bridge consists of four arms. The inductive arms, L1b and L1c, form a trifilar-wound transformer over a ferrite core with L1a, so a signal applied to L1a is injected into the bridge circuit. The measurement consists of a series circuit made up of a 200-ohm potentiometer (R8) and a 250-pF variable capacitor (C8). The potentiometer sets the range (0-200 ohms) of the resistive component of measured impedance, while the capacitor sets the reactance component. Don't use a wire-wound potentiometer for R8. Capacitors C6/C7, in the unknown arm

of the bridge, balance the measurement capacitor and should have a total value equal to one-half C8 (or about 125 pF). The bridge is balanced when C8 is in the center of its range and R8 is set to the resistance connected across J2, with C6/C7 in the circuit. This arrangement accommodates both inductive and capacitive reactances, which appear on either side of the "zero" point — the midrange capacitance of C8. When the bridge is in balance, the settings of R and C reveal the impedance across the unknown terminal.

A reverse-biased zener diode (zeners normally operate in the reverse-bias mode) produces a large amount of noise because of the avalanche process inherent in zener operation. While this noise is a problem in many other applications, it is highly desirable in a noise bridge; the richer the noise spectrum, the better the performance. The spectrum is enhanced because of the 1-kHz square-wave modulator that chops the noise signal. An amplifier boosts the noise signal to the level needed in the bridge circuit.

The detector used in the noise bridge is a tunable receiver which covers the frequencies of interest. The preferred receiver uses an AM demodulator, but both CW and SSB receivers will do in a pinch. The type of receiver you need depends on how precise an operating frequency is required for the device under test.

Adjusting antennas

Finding the impedance and resonant points of an HF antenna is perhaps the most common use for the antenna noise bridge. Connect the RECEIVER terminal of the bridge to the ANTENNA input of the HF receiver with a short length of coaxial cable. This length should be as short as possible, and the characteristic impedance should match that of the antenna feedline. Now, connect the coaxial feedline from the antenna to the ANTENNA terminals on the bridge. You're now ready to test the antenna.

Finding impedance. Set the noise bridge resistance control to the

antenna feedline impedance (usually 50 or 75 ohms for most common antennas). Set the reactance control to midrange (zero). Next, tune the receiver to the antenna's *expected* resonant frequency (F_{exp}). Turn the noise bridge on, and look for a noise signal of about S9 (will vary on different receivers).

Adjust the *resistance* control (R) on the bridge for a null; i.e., minimum noise as indicated by the S-meter. Next, adjust the *reactance* control (C) for a null. Continue adjusting the R and C controls for the deepest possible null, as indicated by the lowest noise output on the S-meter (there is some interaction between the two controls).

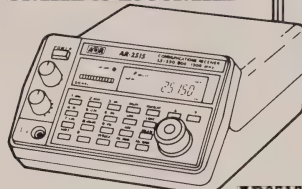
A perfectly resonant antenna will have a reactance reading of zero ohms, and a resistance of 50 to 75 ohms. Real antennas may have some reactance (the less the better), and a resistance that is somewhat different from 50 or 75 ohms. You can use impedance-matching methods to transform the actual resistive component to the 50 or 75-ohm characteristic impedance of the transmission line. Here are the results you can expect:

1. If the resistance is close to zero, suspect that there's a short circuit on the transmission line; suspect an open circuit if the resistance is close to 200 ohms.
2. A reactance reading on the X_L side of zero indicates that the antenna is too long, while a reading on the X_C side of zero indicates the antenna is too short.

Adjust an antenna that's too long or too short to the correct length. To determine the correct length, you must find the actual resonant frequency, F_r . To do this, reset the *reactance* control to zero and then **slowly** tune the receiver in the proper direction — downband if it's too long and upband if it's too short — until you find the null. On a high-Q antenna the null is easy to miss if you tune too fast. Don't be surprised if that null is out of band by quite a bit. Find the percentage of change by dividing the expected resonant frequency (F_{exp}) by the actual resonant frequency (F_r), and multiply-

New from AOR

**2000 Channels
5MHz to 2000MHz**



AR2515

- Covers 5MHz to 2000MHz in AM/FM/Wide FM modes. Continuous coverage.
- 2000 Channel Memory. 1984 Scan Frequencies & 16 Search Groups.
- Scan/Search speeds up to 36 channels or increments per second.
- Built in RS 232 computer interface.
- 25 Day Satisfaction Guarantee. Full Refund if not Satisfied.
- Size: 3 1/4" H x 5 1/4" W x 7 1/4" D. Wt.: 2 lb. 10 oz.
- Supplied with AC & DC power cords. Telescopic antenna.

\$695.00

**ACE
COMMUNICATIONS**
10707 E. 106th St. Indpls., IN 46256
Toll Free 800-445-7717

Visa and MasterCard
(COD slightly higher)
In Indiana 317-849-2570 Collect FAX (317) 849-8794



143

NEW SUPER LONG PLAY TAPE RECORDERS

12 Hour Model — \$119.00*
USES D-120 TAPE

Modified Panasonic Slimline, high quality, AC-DC Recorders provide 6 continuous hours of quality recording & playback on each side of cassette. Built-in features include:

- Voice level control.
- Digital counter, etc. TOK DC 120 Cassette Furnished.



PHONE RECORDING ADAPTER

Records calls automatically. All Solid state connects to your telephone jack and tape recorder. Starts recording when phone is lifted. Stops when you hang up.

\$24.95*
FCC APPROVED

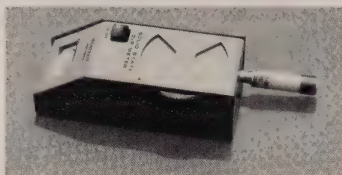
VOX VOICE ACTIVATED CONTROL SWITCH

Solid state. Self contained. Adjustable sensitivity. Voices or other sounds automatically activate and control or remote mike.

\$28.50*

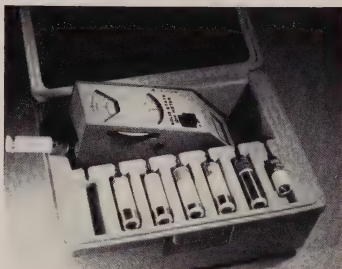
*Add for ship & hndg. Phone Adapter & Vox \$150 ea. Records \$400 ea. Cal. Res. add tax. Mail order, VISA, MIC, COD's OK. Money Back Guarantee. Qty. disc. avail.. Dealer inquiries invited. Free data. ©
AMC SALES INC. Dept H, 9335 Lubec St., Box 928, Downey, CA 90241 Phone (213) 869-8519

PHOTO C



Heath dip oscillator ready for use.

PHOTO D



Heath dip oscillator in case.

ing by 100: $\text{Change} = (F_{\text{exp}} \times 100 \text{ percent}) / F_L$.

Resonant frequency. Connect the antenna, noise bridge, and receiver as you did before. Set the receiver to the expected resonant frequency — approximately 468/F for half-wavelength types and 234/F for quarter-wavelength types. Set the resistance control to 50 or 75 ohms, as appropriate for the normal antenna impedance and the transmission line impedance. Set the reactance control to zero. Turn the bridge on and listen for the noise signal.

Slowly rock the reactance control back and forth to find on which side of zero the null appears. Once you've determined the null's direction, set the reactance control to zero and tune the receiver towards the null (downband if the null is on the X_L side and upband if on the X_C side of zero).

A less than ideal antenna won't have exactly 50 or 75-ohm impedance, so you'll have to do some adjustment of R and C to find the deepest null. You'll be surprised how far off some dipoles and other forms of antennas can be if they aren't in "free space;" i.e., they're close to the ground.

Dip oscillators

One of the most common instruments for determining the resonant frequency of an antenna is a "dip oscillator," or "dip meter" (see **photo C** and **D**). This instrument was originally called the "grid dip meter." The meter works because its output energy can be absorbed by a nearby resonant circuit, or antenna (which electrically is a resonant LC tank circuit). When the inductor of the dip oscillator is brought into close proximity with a resonant tank circuit, and the oscillator is operating on the resonant frequency, a small amount of energy is transferred. This energy loss appears on the meter pointer as an extremely sharp dip; you can miss it if you tune the meter frequency dial too rapidly.

Antennas are resonant circuits and can be treated in a manner similar to LC tank circuits. **Figure 2A** shows one way to couple the dip oscillator to a vertical antenna radiator. Bring the inductor of the dipper into close proximity with the base of the radiator. **Figure 2B** illustrates the way to couple dip oscillators to systems where the radiator is not easily accessible (as when the antenna is still erected). Connect a small 2 or 3-turn loop to the transmitter end of the transmission line, and then bring the inductor of the dipper close to it. A better way to do this is to connect the loop directly to the antenna feedpoint.

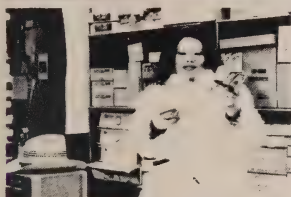
There are two problems to be aware of when using dip meters. As I said before, the dip is very sharp — it's easy to tune past it and miss it. To make matters worse, it's normal for the meter reading to drop off gradually from one end of the tuning range to the other. But if you tune very slowly, you'll notice a very sharp dip when you reach the resonant point.

The second problem concerns the dial calibration. The dial gradations of inexpensive dip meters are too close together and often erroneous. You'll be better off if you monitor the output of the dip oscillator on a receiver, and depend upon the receiver calibration for data.

WE SHIP WORLDWIDE

Barry Electronics Corp.

WORLD WIDE AMATEUR RADIO SINCE 1950
Your one source for all Radio Equipment!



See you Feb. 5th—Limarc, LI, N.Y.

KITTY SAYS: WE ARE NOW OPEN 7 DAYS A WEEK.

Saturday & Sunday 10 to 5 P.M.

Monday-Friday 9 to 6:30 PM Thurs. to 8 PM
Come to Barry's for the best buys in town.



ONV Safety
belts-in stock

YAESU

FT-767GX, FT-757GXII,
FRG-8800, FT-736, FRG-9600,
FT-4700RH, FT 212/712RH.

YAESU
FT-237/33/727R
FT411-811
FT-1903/1123
FTH-2005/7005

ICOM
IC2AT/12AT
IC20AT-32AT
IC2/4GAT
IC-A2/U16

Landmobile HT's
ICOM: U16, H16, V100, U400
MAXON, MOTOROLA
YAESU: FTH 2005/2007
UNIDEN, REGENCY, KING, TAD
MARINE ICOM: M5, M55, M700
AVIATION ICOM: A20 H.T.

KENWOOD



Antennas

A-S, AES, Cushcraft, Hy-Gain,
Hustler, KLM, METZ, Mosley,
MODULBOX, TONNA, Butternut

TS440S/AT, R-5000, R-2000, TS-940 S/AT, TM
221A/421A, TM-2570A/50A/30A, TR-751A, Ken-
wood Service Repair, TM-721A, TS-711/811A,
TM3530A, TH205AT, TH215A, TM-621A, TM-
321A, TS140S, TS680S, RZ-1, TS-790A.

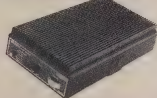
Budwig ANT. Products
NEL-TECH DVK-100 Digital Voice Keyer
FLUKE 77 Multimeter

Media Mentors—
Amateur Radio Course \$99.95

VoCom/Mirage/Alinco
Tokyo Hy-Power/TE SYSTEMS
Amplifiers &
5/8λ HT Gain
Antennas IN STOCK

MICROLOG-ART 1, Air Disk,
SWL, Morse Coach

Soldering Station 48 Watts \$68.



METRON MA-1000 B STOCKED

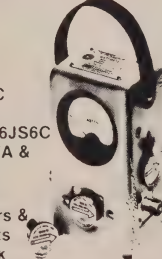
AEA 144 MHz
AEA 220 MHz
AEA 440 MHz
ANTENNAS

EIMAC
3-500Z
572B, 6JS6C
12BY7A &
6146B

BIRD
Wattmeters &
Elements
In Stock

Computer Interfaces
Stocked: MFJ-1270B
MFJ-1274, MFJ-1224, AEA
PK-88, MFJ-1278, PK-232
W/FAX.

AR 900 Hand Held Scanner 100
ch. Covers 27-54, 108-174,
406-512, 800-950 MHz \$299



ALINCO ALD 24T
DJ-100T

FREQUENCY
COUNTERS:
1MHz-1.3GHz
\$169.95

COMMERCIAL
& HAM
REPEATERS
STOCKED.
WRITE FOR
QUOTES

KANTRONICS
UTU, KAM, UTU-XT,
KPC 2400, KPC IV,
KAM

MOTOROLA AUTHORIZED DEALER
KACHINA COMMUNICATIONS DEALER

SHORTWAVE RECEIVERS STOCKED

DIGITAL FREQUENCY COUNTERS
Opto-electronics model 1300H, 0-1300MHz
Trionix, Model TR-1000, 0-600 MHz
Long-range Wireless
Telephone for export in stock

BENCHER PADDLES,
BALUNS, LOW PASS FILTERS
IN STOCK

MIRAGE AMPLIFIERS
ASTRON POWER SUPPLIES
Saxton Wire & Cable, Int'l Wire

For the best buys in town call:
212-925-7000
Los Precios Mas Bajos en Nueva York
WE SHIP WORLDWIDE!

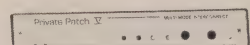


IC-R71A, 751A, 781, 28A/H, 38A, 48A, Micro2/4,
R-7000, IC-761, IC-375A, 275A/H, 3210A, 475A/
H, 735, IC-900, IC-228H, IC448A, IC725



SMART PATCH

CES Simplex Autopatch 510-SA Will Patch FM
Transceiver To Your Telephone Great For
Telephone Calls From Mobile To Base. Simple
To Use. 510SA/510SAII



PRIVATE PATCH V, Duplex 8000

TUNERS STOCKED:
NYE MBV-A 3 Killowatt Tuner



MFJ-989C



Ten-Tec
Tuner 229B

COMET ANTENNAS
STOCKED

HEIL
EQUIPMENT
IN STOCK



SANGEAN Portable Shortwave Radios



New TEN-TEC
Corsair II, PARAGON,
OMNI V

IIX Towers, Antennas,
Mobile Radio mounts
stocked. Call.

AMERITRON AUTHORIZED DEALER

MAIL ALL ORDERS TO: BARRY ELECTRONICS CORP., 512 BROADWAY, NEW YORK CITY, NY 10012 (FOUR BLOCKS NORTH OF CANAL ST.)

New York City's LARGEST STOCKING HAM DEALER COMPLETE REPAIR LAB ON PREMISES

"Aquí Se Habla Español"

BARRY INTERNATIONAL TELEX 12-7670
MERCHANDISE TAKEN ON CONSIGNMENT
FOR TOP PRICES

Monday-Friday 9 A.M. to 6:30 P.M. Thursday to 8 P.M.
Saturday & Sunday 10 A.M. to 5 P.M. (Free Parking)

IRT/LEX-"Spring St. Station", Subways: BMT-
"Prince St. Station", IND-"F" Train-Bwy Station"

Bus: Broadway #6 to Spring St. Path-9th St./6th Ave.
Station.

COMMERCIAL RADIOS
STOCKED: ICOM, Motorola,
MAXON, Standard,
Yaesu. We serve municipa-
lities, businesses, Civil
Defense, etc. Portables,
mobiles, bases, re-
peaters...

ALL
SALES
FINAL

We Stock: AEA, ARRL, Alinco, Ameco, Ameritron, Antenna Specialists,
Astatic, Astron, B&K, B&W, Benchner, Bird, Butternut, CDE, CES, Cushcraft,
Daiwa, Eimac, Henry, Heil, Hustler, Hy-Gain, Icom, KLM, Kantronics, Larsen,
MJJ, J.W. Miller, Mirage, Nye, Palomar, RF Products, Saxton, Shure,
Tempo, Ten-Tec, TUBES, Yaesu, Vibroplex, Duplexers, Repeaters, Scan-
ners, Radio Publications, Uniden, Kenwood, Maxon, RFC.

WE NOW STOCK COMMERCIAL COMMUNICATIONS SYSTEMS
HAM DEALER INQUIRES INVITED PHONE IN YOUR ORDER & BE REIMBURSED
COMMERCIAL RADIOS stocked & serviced on premises.
Amateur Radio Courses Given On Our Premises, Call
Export Orders Shipped Immediately. TELEX 12-7670

FAX: 212-925-7001

Calling all hams! ORANGE COUNTY HAMCATION AND COMPUTER SHOW



★ REGISTRATION ★

\$6.00 Advance

(Until March 15th)

\$8.00 at the door

Children under 12 Free!

*"C'mon down and enjoy
our Southern Hospitality"*

Build your
next vacation
around the south-
land's most popular
Hamfest, at the hub of
the greatest entertainment
and activity center in the east.

at **ORANGE COUNTY CIVIC CENTER**

(at INTERSTATE 4, EXIT 29)

ARRL

Northern Florida
Section Convention
April 7th, 8th, 9th

—1989—

**NOW BIGGER & BETTER
THAN EVER!**

For General Information & Tickets - Registrants and Exhibitors contact:
Hamcation Information • P.O. Box 547811, Orlando, FL 32854
ORLANDO HAMCATION & COMPUTER SHOW
Sponsored by: Orlando Amateur Radio Club, Inc.

HAMCATION CHAIRMAN: Larry Gilbreath

General Information: (407) 657-9052 Commercial Information: (407) 898-1027

Ask for Buzz Showalter

**Hamcation only minutes away
from Florida's main attractions!**

- ★ Disney World ★ EPCOT Center
- ★ Sea World ★ Wet n' Wild ★ Water Mania ★ Boardwalk & Baseball
- ★ Gatorland Zoo ★ Xanadu
- ★ Church Street Station

- ★ **24 Hour RV Sites** at nearby campground
- ★ **Continuous Forums** Saturday and Sunday
- ★ **FCC EXAMS** Sunday at 9:00 am
★ **FREE Novice Exam** - all others \$4.00
Form 610 provided. Register for exams on Saturday. Bring credits and license.
- ★ **EXPANDED INDOOR SWAP TABLES**
(\$25.00 for all three days)
Commercial Exhibit Areas

Super Comshack 64 Repeater Controller

Programmable Controller/HF & VHF Remotes/Autopatch/CW Practice
Rotor Control/Voice Meters/Paging/Logging/Unlimited Vocabulary



\$349.95

Unlimited Speech Mail box Alarm Clock/Macros
Logging/CW Practice/Talking Meters/400 Users
1,020 Tel. #'s Stored - Directed Call & Rev. 2 Tone
Paging - Call waiting - Quick dial - Dual Remotes
Macro Mem. "Security Mode" Police ID's Program
via Packet & Speech packet B.B.S. user messages

Computer Control
VAESU FT-727B

Comshack Options
PATCH External relay coil - 1.000
Remote Control - 2.500
Water control C.O. to digital display &
voice tracing - 2.500
Packet Control & BBS - voice tracing
Alarm tracing - 1.000
UPROM Autotest - custom PROM card
with your application - 9.99
Manual (included) - 1.000
Package price varies
transceivers with
purchase of COMSHACK

Decode-A-Pad
Transceiver to RS232
300 Baud Interface

12 v. C64 Switcher
Crystal 60 Hz 5 VAC
& 5 VDC 2.5 Amp.
Plugs in C64; 75% Eff.
Plugs in C64; 75% Eff.
Plugs in C64; 75% Eff.

Model DAP \$89.95

Engineering Consulting
583 CANDLEWOOD ST. BREA, CA 92621
FAX: 714-255-9884 • TEL: 714-671-2009
Please add \$3.00 Shipping, Ca. resident add 6%; Ask for free catalog

ADD A VOICE TO ITC-32

SP-1 Speech Processor

With the SP-1 Speech Synthesizer your
ACC ITC-32 controller will sound exactly
like an RC-85/850, for a lot less money.
The SP-1 directly connects to the ITC-32
and is transparent to system operation
when the ITC-32 personality PROM is
programmed to support the Digitaltalker
interface. Nearly 200 words, numbers and
letters are included as standard. Uses an
8-bit parallel interface with strobe and
handshake. Use with any external device
which uses simple parallel interface. In-
cludes on-board audio mixer to make in-
terfacing a snap. \$145 PP. Please request
information packet.

Gary Gaugler, N6OJJ
7970 Twin Rocks Rd Loomis, CA

EVERY ISSUE of

HAM RADIO

now available on microfiche!

The entire run of *Ham Radio Magazine*
(March, 1968 thru last year) is ready
to ship to you in one, easy to use
format.

Our 24x microfiche is easy to read and
very compact. We offer a hand held
reader for \$75, and a desk model for
\$200. Libraries have these readers.

As a bonus, you will receive *Ham
Radio Horizons* (3/77 thru 12/80) free.

Everything is included, front cover to
back - ads too!

Annual updates will be offered for \$10.

Send \$185 payment (visa/mc
accepted) to:

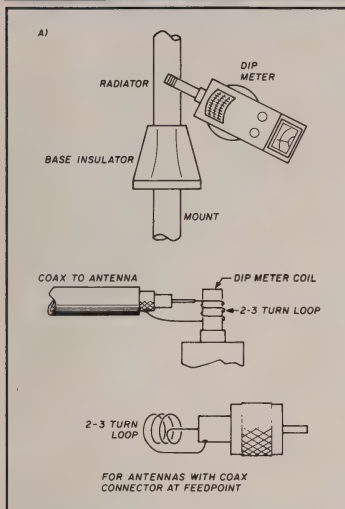
BUCKMASTER

BUCKMASTER PUBLISHING

Route 3, Box 56

Mineral, Virginia 23117

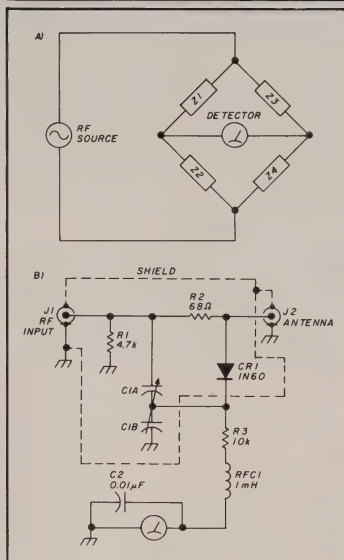
703/894-5777 visa/mc 800/282-5628

FIGURE 2


Coupling the dip oscillator to antennas. (A) directly, (B) indirectly.

Impedance bridges

It's important to know the antenna feedpoint impedance when designing and developing tactics for impedance-matching networks. Although it's best to measure the impedance exactly at the feedpoint of the antenna, it's very difficult to do. It isn't possible to measure the impedance on the ground and then expect it to be the same "at altitude" after you've erected the antenna. But there's hope for good measurements. Remember your basic transmission line theory? The load impedance value is reflected every half wavelength down the line. In other words, if you make the transmission line exactly an integer multiple of a half wavelength, the impedance measured at the input end will be the load impedance at the other end. The length of the line (in feet) should be $[(492 \times N) / F_{\text{MHz}}]$, where N is an integer (1, 2, 3, ...), V is the velocity factor of the transmission line used, and F_{MHz} is the frequency in megahertz. Although there's error involved because some coaxial transmission lines don't exhibit precisely the advertised velocity factor, the error is small enough to be ignored in most cases.

FIGURE 3


(A) Universal bridge circuit, (B) Amateur impedance bridge project.

Figure 3A shows the basic form of a simple impedance bridge. There are four arms, each representing an impedance. In general, two will be fixed, one will be variable and connected to a calibrated dial, and one will be the antenna. Another common arrangement is to have one fixed, two in the same "stack" (e.g., $Z1/Z2$) that are differentially variable, and the other as the antenna impedance. The bridge is in null (detector reads zero) when $[Z1/Z2] = [Z3/Z4]$.

Figure 3B shows an impedance bridge construction project you can build. The heart of this instrument is C1A/B, which is a 200 or 250-pF differential capacitor. The exact value isn't critical, but the range is affected. You can purchase these capacitors from Radiokit in Pelham, New Hampshire.* In order to read impedance values you'll need to supply a calibrated dial for the capacitor.

The value of resistor $R2$ is ideally 50 or 75 ohms. Select it to match the impedance of the antenna being measured. Selecting 68-ohm, 2-watt, carbon composition for $R2$ is a reason-

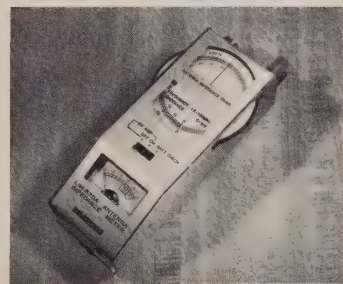
able compromise. If you build this project, be sure to shield the RF components from the DC ones. The entire project is built in a shielded box, but the RF components should be shielded separately from the others.

Calibration is simple. Select a handful of carbon composition resistors with values ranging from about 1 to 300 ohms. These are connected across J2, each in its turn. Make sure to represent 50 and 75 ohms in your collection so that you can find exact points on the dial. Find the null for each resistor using a low-power source, and mark its spot on the dial. Now calibrate the dial for the values you've selected.

The Leader Electronics commercial impedance bridge model shown in photo E is intended for Amateur applications. It contains an internal amplifier so that it can be used with ordinary signal generators, or in the "straight through" mode for use with low-power Amateur Radio transmitters.

VSWR bridges

Voltage Standing Wave Ratio (VSWR) indicates how well an antenna is matched to its source. Photo F shows a simple, low-cost bridge that will measure forward and reflected "relative" power. Although there's a calibration setting on the sensitivity potentiometer for measuring the output power of low-power transmitters, it's not too accurate for measuring RF power. However, it is good as a VSWR meter. One meter measures the forward power, while the

PHOTO E


Commercial impedance bridge.
*P.O. Box 973, 03076

2x4Z BASE REPEATER ANTENNA

THE HIGHEST GAIN
DUAL BAND
BASE/REPEATER ANTENNA

HIGH POWER 200 WATTS

CENTER FREQUENCY

146.500 MHz

446.500 MHz

GAIN:

VHF - 8.2dB

UHF - 11.5dB

VSWR - 1-1.2 or less

CONNECTOR:

N TYPE FEMALE

LIGHTNING PROTECTION
GROUNDED DIRECT

LENGTH: 16 FT.

WEIGHT: 5 LBS. 3 OZ.

WIND LOAD: 90 MPH

MOUNTING: UP TO 2 IN.

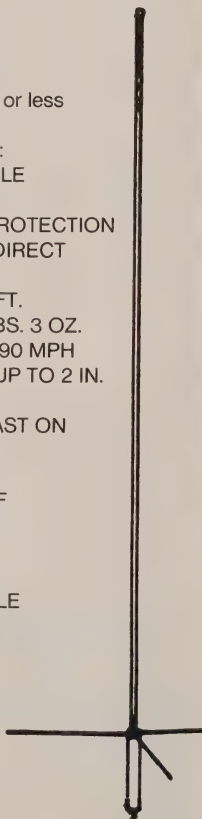
MAST

CAN SIMULCAST ON
BOTH BANDS

WATERPROOF
CONNECTING
JOINTS

UPS SHIPPABLE

✓ 147



AMATEUR SPECIAL



1275 NORTH GROVE ST.
ANAHEIM, CALIF. 92806
(714) 630-4541

CABLE: NATCOLGLZ
FAX (714) 630-7024

NEW OSCAR

BRIDGES HAMISPHERE

- Coming soon to a shack near you.
- Signals from space.
- Catch some free.
- We know how.
- You can too!
- Join AMSAT
- Free brochure for SASE

AMSAT
PO BOX 27
WASHINGTON, DC 20044

HI-PERFORMANCE DIPOLES

Antennas that work! Custom assembled to your center freq. ea. band - advise ht. of center and each end - hang as inverted "V" - horizontal, vert. dipole, sloping dipole - commercial quality - stainless hardware - legal power - no trap, high efficiency design. Personal check, MO or C.O.D. (\$3)

MPD-5*	80-40-20-15-10M max performance dipole 87' long	.....	\$105ppd
MPD-2	80-40M max performance dipole 85' long 562	.....	95' 146ppd
HPD-3*	160-80-40M hi-performance dipole 113' long	.....	\$79ppd
SSD-4*	160-80-40-20-15-10M space saver dipole 71' long	.....	\$125ppd
SSD-5*	80-40-20-15-10M space saver dipole-specify L 42'-\$105	.....	\$2-\$108ppd
SSD-4*	80-40-20-15M space-saver dipole-specify L 46'-\$93	.....	60'-\$ 96ppd

*9-bands with wide-matching-range tuner.
SASE for catalogue of 30 dipoles, slopers, and space-saving, unique antennas
312-394-3414 **WISN ANTENNAS**
BOX 393 MT. PROSPECT, IL 60056

✓ 148

U.S. AMATEUR RADIO MAIL LISTS

Labels, floppy disks, CD-ROM, mag tape.

- Newly licensed hams
- All upgrades
- Updated each week

BUCKMASTER PUBLISHING

Route 3, Box 56

Mineral, Virginia 23117

703/894-5777 visa/mc 800/282-5628

✓ 149

Foreign Subscription Agents for Ham Radio Magazine

Ham Radio Austria
Karin Ueber
Postfach 2454
D-7850 Loerrach
West Germany

Ham Radio Belgium
Stereohouse
Brusselssteenweg 416
B-9218 Gent
Belgium

Ham Radio Holland
Postbus 413
NL-7800 Ar Emmen
Holland

Ham Radio Europe
Box 2084
S-194 02 Upplands Vasby
Sweden

Ham Radio France
SM Electronic
20 bis, Ave des Clairons
F-90000 Auxerre
France

Ham Radio Germany
Karin Ueber
Postfach 2454
D-7850 Loerrach
West Germany

Canada
Send orders to
Ham Radio Magazine
Greenville, NH 03048 USA
Prices in Canadian funds
1 yr. \$41.95, 2 yrs. \$74.25
3 yrs. \$99.90

Ham Radio Italy
Via Manago 15
I-20134 Milano
Italy

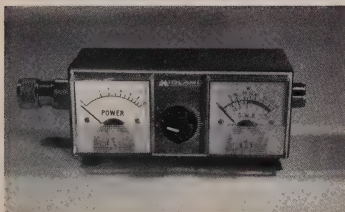
Ham Radio Japan
Katsumi Electronic Co., Ltd.
27-5 Ikegami
4 Chome, Ota-Ku
Tokyo 146, Japan
Telephone (03) 753-2405

Ham Radio Switzerland
Karin Ueber
Postfach 2454
D-7850 Loerrach
West Germany

Ham Radio England
c/o R.S.G.B.
Lambda House
Cranborne Road
Pottery Bar
Herts EN6 3JW
England

Holland Radio
143 Greenway
Greenside, Johannesburg
Republic of South Africa

PHOTO F



Two-indicator VSWR bridge.

other measures the reverse power. Once again, it's relative power that's being measured. Using the calibration knob, set the forward meter to exactly full scale with RF power applied. You can then read the VSWR from the reverse meter. In a future column I'll deal with the construction of various RF wattmeters and VSWR meters.

Conclusion

Antenna instruments are generally inexpensive, especially when compared with the cost of some antennas and transceivers on the market today.

Some Amateurs feel they don't need to own such instruments. Yet they are so useful in "doping out" antenna systems, both when designing new installations and troubleshooting existing ones, that you'll find one handy. If you don't believe you need antenna instruments, then I've got a bridge up in K2-land to sell you.

Special note

The toroids column was suggested to me by a reader who must be a very special guy. Next time you buy a bottle of wine that bears the Bully Hill label, remember it's made by Walter Taylor, K2MLT. Because of legal problems with the Taylor Wine people, he can't use his own name — so call him Walter _____. The artwork labels are a treat! Thanks, Walter.

You can reach me at POB 1099, Falls Church, Virginia 22041. I'd like to have your comments and suggestions for this column.

Article I

HAM RADIO

Rocky Mtn. Shortwave Amateur Specialists

YAESU • TEN-TEC • NRD525 • GRUNDIG
SONY • MAGNAVOX • AMERITRON • MFJ
METZ • ICOM • DAIWA • KLM/MIRAGE
ALPHA DELTA • FAX/RITTY • KENWOOD
BENCHER • and others



FT-767

Allied Appliance & Radio

4253 So. Broadway • Englewood, CO 80110
VISA/MC • Discount Prices • \$1.00 For List

303-761-7305

NEW!

The classic "Antenna Bible"
now in a thoroughly-revised, much-enlarged
edition

ANTENNAS

2nd edition

by John Kraus, W8JK
Ohio State University

Covers both theory and its applications to practical systems. Over 1000 illustrations and nearly 600 worked examples and problems. Over 100 new topics. Complete with design formulas, tables and references

917 pages, hardcover. \$51.95

Add \$2.50 per book for shipping and handling U.S., \$5.00 elsewhere.

CYGNUS-QUASAR BOOKS
P.O. Box 85, Powell, Ohio 43065
Tel. 614-548-7895

✓ 150

Hi Pro Repeaters ELCO

MAGGIORE ELECTRONIC LAB.

Manufacturers of Quality Communications Equipment

- Repeaters
- Links
- Remote Base
- VHF, UHF
- Receivers
- Transmitters
- Antennas



- Standard and Computerized Controllers
- Standard and Computerized Auto Patches
- Duplexers

Hi Pro 'E' EXPANDABLE REPEATER SYSTEM

- A NEW CONCEPT IN REPEATER DESIGN, THE Hi Pro "E" IS AN EXPANDABLE REPEATER WITH THE FOLLOWING FEATURES: A BASIC REPEATER WHICH WOULD INCLUDE A COMPLETE RECEIVER, TRANSMITTER, COR, FRONT PANEL CONTROLS AND INDICATORS, LOCAL SPEAKER AND MIC JACK AND CAPABLE OF FUTURE EXPANSION. ALL HOUSED IN AN EXTREMELY RUGGED, ENCLOSED, 19-INCH RACK MOUNTABLE CABINET.
- THIS SYSTEM CAN BE EXPANDED AT TIME OF PURCHASE OR CAN BE AN AFTER-PURCHASE ADD ON. THE ADD ONS ARE—HIGHER POWER, 110/220 VAC POWER SUPPLY, IDENTIFIER, AUTO PATCH, OR COMPUTER CONTROLLERS. IN ADDITION TO THESE ADD ONS AN ADDITIONAL RECEIVER AND TRANSMITTER CAN BE MOUNTED INTERNALLY FOR USE AS CONTROL LINKS, REMOTE BASE OR DUAL BAND OPERATION, ETC.
- AN EXTENSION PANEL IS AVAILABLE FOR LOCAL MONITORING OF THE REPEATER AND CONTAINS ALL NECESSARY METERING, STATUS LIGHTS AND INDICATORS. ALL ADD ONS ARE AVAILABLE FROM THE COMPANY AND ARE COMPLETE INCLUDING INSTRUCTIONS.

MAGGIORE ELECTRONIC LAB.

600 Westtown Rd.

West Chester, PA 19382

Phone (215) 436-6051



Telex 499 0741 MELCO

WRITE OR CALL FOR OUR COMPLETE CATALOG

Monitor More With the New Universal M-7000!



If you are monitoring only *voice* shortwave stations, you are missing half the action! Thousands of shortwave stations transmit in non-voice modes such as Morse code, various forms of radioteletype (RTTY) and facsimile (FAX). The Universal M-7000 will permit you to easily intercept and decode these transmissions. Simple connections to your shortwave receiver and video monitor will enable you to monitor with the most sophisticated surveillance decoder available. No computer is required. See the world of shortwave excitement you have been missing. Requires 115 or 230 VAC. Six month limited warranty.

* FULL CATALOG AVAILABLE *

Universal offers a comprehensive shortwave catalog covering all types of shortwave monitoring equipment including receivers, antennas, RTTY and FAX equipment plus books and accessories. Send \$1 (refundable) to receive your copy today.

Universal M-7000 Introductory Pricing:

Standard M-7000	\$ 999.00
With Real Time Clock Option	\$1059.00
With Video FAX Option	\$1089.00
With Clock & Video FAX Option ..	\$1129.00
Shipping/Handling (USA)	\$ 11.00

UNIVERSAL...Serving Radio Enthusiasts Since 1942

Partial List of Modes & Features

- ◆ Morse Code (CW)
- ◆ Regular Baudot RTTY
- ◆ Variable Speed Baudot
- ◆ Bit Inverted Baudot
- ◆ ASCII Low Speed
- ◆ ASCII High Speed
- ◆ ASCII Variable Speed
- ◆ Sitor Mode A (ARQ)
- ◆ Sitor Mode B (FEC)
- ◆ Autor
- ◆ ARQ 2&4 chan. (TDM)
- ◆ VFT Modes (FDM)
- ◆ Russian 3rd Shift Cyrillic
- ◆ Facsimile (FAX) AM
- ◆ Facsimile (FAX) FM
- ◆ Packet AX.25
- ◆ Literal Mode
- ◆ Databit Mode
- ◆ Diversity Reception
- ◆ Dual Metering
- ◆ Low Tone & High Tone
- ◆ Variable & Standard Shift
- ◆ Option: Real Time Clock
- ◆ Option: Video Display of Facsimile (FAX)
- ◆ Option: Rack Mounting Brackets (For 19")
- ◆ Speed Readout
- ◆ 4 TTY Alphabets
- ◆ Ten Memories
- ◆ Automatic Tuning
- ◆ Video Squelch
- ◆ Audio Squelch
- ◆ Split Screen ARQ
- ◆ Self Diagnostics
- ◆ Screen Print
- ◆ Screen Saver
- ◆ Input Gain Control
- ◆ MSI, UOS, ATC
- ◆ User Programmable Sel Cals
- ◆ Serial & Parallel Printer Ports
- ◆ Remote Terminal Operation
- ◆ Direct Entry of Baud & Shift
- ◆ Auto-Start

Universal Radio

1280 Aida Dr. Dept. H
Reynoldsburg, OH 43068
Toll Free: 800 431-3939
In Ohio: 614 866-4267

NUTS & VOLTS MAGAZINE

P.O. Box 1111-H
PLACENTIA, CA 92670
714-632-7721



Ham Radio
Computer Hardware
Computer Software
Plans-Kits
Schematics
Test Equipment
CB Gear
Satellite TV
Video
Components
Antique Electronics
Cable TV
Publications
Repairs-Services
New Products
Events Calendar

IF YOU ARE INTO ELECTRONICS AND SAVING MONEY IS IMPORTANT TO YOU, THEN YOU OWE IT TO YOURSELF TO TRY NUTS & VOLTS MAGAZINE. DISCOVER WHY THOUSANDS OF SMART PEOPLE NATIONWIDE TURN TO NUTS & VOLTS EACH MONTH TO MEET THEIR ELECTRONIC NEEDS. WHETHER YOU'RE BUYING, SELLING, OR JUST TRYING TO LOCATE THOSE UNIQUE OR HARD-TO-FIND ITEMS, FIND OUT HOW NUTS & VOLTS CAN HELP!

SUBSCRIBE TODAY!

☐ CHECK ☐ MONEY ORDER ☐ VISA ☐ MC

Name _____

Address _____

City _____

State _____ Zip _____

Card No. _____ Exp. Date _____

CALL FOR ADVERTISING INFORMATION
DISTRIBUTOR INQUIRIES INVITED

Subscription Rates

U.S. FUNDS REQUIRED

3rd Class Mail - USA

One Year	\$12.00
Two Years	\$21.00
Lifetime	\$60.00

1st Class Mail

One Year - USA ..	\$20.00
Canada & Mexico ..	\$22.00

Air Mail

Foreign - 1 Year ..	\$55.00
---------------------	---------

Includes one FREE 40-word
Classified Ad ✓ 151

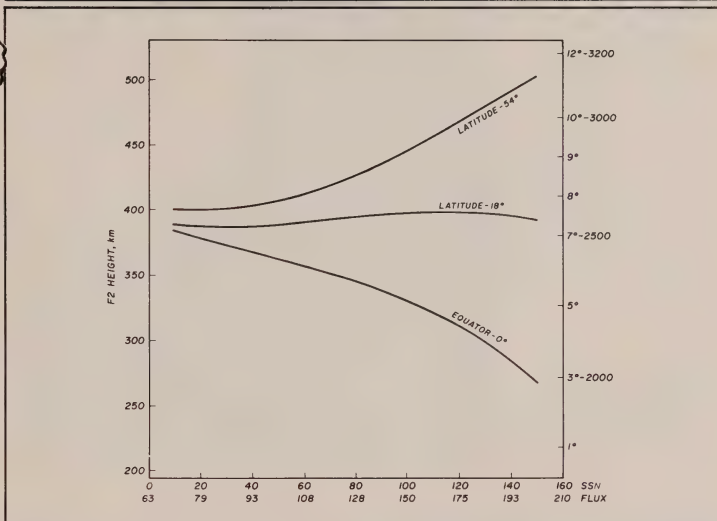
A National Publication For The Buying And Selling Of Electronic Equipment



DX FORECASTER

Garth Stonehocker, KØRYW

FIGURE 1



Cycle 22's increasing sunspot numbers and their effect on the F2 layer's average height.

More new cycle 22 DX

The new sunspot cycle nears its maximum by the end of 1989, causing some changes in signal propagation. The lower ionosphere (D & E) regions will increase by 30 percent, but the F region changes are more involved. Up there the geomagnetic field defines and controls the electron-ion density and altitude changes. Ion density will be generally increased, but the amount will vary with location. **Figure 1** shows the changes in height, both up and down. See the left ordinate scale at the latitude regions.

The height of refraction in the ionosphere determines the geometrical conditions of the maximum distance for DX. The earth tangent points spread out as the height increases. The figure's right-hand ordinate scale shows this change in hop length at a 10 degree take-off angle. If you have a favorite DX spot, the distance is fixed. For the signal to get to this same spot, the take-off angle will have to change as the height of the ionosphere moves. The angle change is also shown on the **fig. 1** right-hand ordinate scale for 3000-km distance.

Figure 1 is based on theory and geometry backed up by some research measurements. The solar flux and sunspot numbers change daily, and so do the relationships shown in **fig. 1**. On the average, the graph gives a good

idea of what to expect by the end of 1989 or so. The hop distance, long skip, should increase by about 400 km on the northern paths to Europe or Japan while decreasing to countries in South America, South Africa, and the South Pacific.

Last-minute forecast

The best days for long-skip openings on the higher frequency bands are the first 12 days of February. Openings of one-long-hop transequatorial skip are probable near the 3rd and 10th to South Africa, South America, and South Pacific areas. Maximum usable frequencies (MUF) are expected to be highest because of high solar flux on these days. The lower bands are expected to be their best during the last two weeks. Disturbed periods from solar flare effects may be evident

near the 3rd, 10th, and 21st with unsettled conditions. As a result of these effects, you can hear decreases in MUF with weak and variable QSB signals on east-west DX paths to Europe and Japan on the lower bands. Shorter nighttime hours will also be evident.

No significant meteor-showers are scheduled to appear in February. A full moon occurs on the 25th; its perigee is on the 13th.

Band-by-band summary

Ten, 12, 15, 17, and 20 meters will be open from morning to early evening almost daily to most areas of the world. Expect the higher band openings to be southerly, shorter, and closer to local noon. Transequatorial propagation on these bands is likely to be toward evening during times of high

WESTERN USA

GMT		N	NE	E	SE	S	SW	W	NW
0000	400	20	30	15	10	10	10	10	12
0100	500	20	30	15	10	10	10	10	12
0200	600	20	30	20	12	10	10	10	15
0300	700	20	30	20	12	10	10	10	15
0400	800	30	30	20	15	12	12	12	20
0500	900	30	30	20	15	12	12	12	30
0600	1000	30	30	20	15	12	15	15	30
0700	1100	30	30	20	20	12	15	15	30
0800	1200	30	30	20	20	15	15	20	30
0900	1300	30	30	20	20	15	20	20	30
1000	1400	30	30	20	20	20	20	20	30
1100	1500	30	30	20	20	20	20	20	30
1200	1600	30	30	20	20	20	20	20	30
1300	1700	30	30	20	20	20	20	20	30
1400	1800	30	30	20	20	20	20	20	30
1500	1900	30	30	20	20	20	20	20	30
1600	2000	30	30	20	20	20	20	20	30
1700	2100	30	30	20	20	20	20	20	30
1800	2200	30	30	20	20	20	20	20	30
1900	2300	30	30	20	20	20	20	20	30
2000	2400	30	30	20	20	20	20	20	30
2100	2500	30	30	20	20	20	20	20	30
2200	2600	30	30	20	20	20	20	20	30
2300	2700	30	30	20	20	20	20	20	30

MID USA

GMT		N	NE	E	SE	S	SW	W	NW
0000	400	20	30	15	10	10	10	10	12
0100	500	20	30	20	12	10	10	10	15
0200	600	20	30	20	12	10	10	10	15
0300	700	20	30	20	12	10	10	10	15
0400	800	30	30	20	15	12	12	12	20
0500	900	30	30	20	15	12	12	12	30
0600	1000	30	30	20	15	12	12	12	30
0700	1100	30	30	20	15	12	12	12	30
0800	1200	30	30	20	15	12	12	12	30
0900	1300	30	30	20	15	12	12	12	30
1000	1400	30	30	20	15	12	12	12	30
1100	1500	30	30	20	15	12	12	12	30
1200	1600	30	30	20	15	12	12	12	30
1300	1700	30	30	20	15	12	12	12	30
1400	1800	30	30	20	15	12	12	12	30
1500	1900	30	30	20	15	12	12	12	30
1600	2000	30	30	20	15	12	12	12	30
1700	2100	30	30	20	15	12	12	12	30
1800	2200	30	30	20	15	12	12	12	30
1900	2300	30	30	20	15	12	12	12	30
2000	2400	30	30	20	15	12	12	12	30
2100	2500	30	30	20	15	12	12	12	30
2200	2600	30	30	20	15	12	12	12	30
2300	2700	30	30	20	15	12	12	12	30

EASTERN USA

GMT		N	NE	E	SE	S	SW	W	NW
0000	400	20	30	15	12	12	12	10	20
0100	500	20	30	20	12	12	15	12	30
0200	600	20	30	20	12	12	15	15	30
0300	700	20	30	20	12	12	15	15	30
0400	800	30	30	20	15	15	20	15	30
0500	900	30	30	20	15	15	20	20	30
0600	1000	30	30	20	15	15	20	20	30
0700	1100	30	30	20	15	15	20	20	30
0800	1200	30	30	20	15	15	20	20	30
0900	1300	30	30	20	15	15	20	20	30
1000	1400	30	30	20	15	15	20	20	30
1100	1500	30	30	20	15	15	20	20	30
1200	1600	30	30	20	15	15	20	20	30
1300	1700	30	30	20	15	15	20	20	30
1400	1800	30	30	20	15	15	20	20	30
1500	1900	30	30	20	15	15	20	20	30
1600	2000	30	30	20	15	15	20	20	30
1700	2100	30	30	20	15	15	20	20	30
1800	2200	30	30	20	15	15	20	20	30
1900	2300	30	30	20	15	15	20	20	30
2000	2400	30	30	20	15	15	20	20	30
2100	2500	30	30	20	15	15	20	20	30
2200	2600	30	30	20	15	15	20	20	30
2300	2700	30	30	20	15	15	20	20	30

The italicized numbers signify the bands to try during the transition and early morning hours, while the standard type provides MUF during "normal" hours.

* Look at next higher band for possible openings.

solar flux and disturbed geomagnetic field conditions.

Thirty and 40 meters will be useful almost 24 hours a day. Daytime conditions will resemble those on 20 meters, but skip and signal strength may decrease during midday on days with high solar flux values. Look for good nighttime use — except pre-dawn after days of very high MUF conditions. Usable distances on these bands should be somewhat greater than that achieved on 80 at night.

Eighty and 160 meters, the nighttime DXer's bands, will open just before sunset and last until sunrise on the path of interest. Except for daytime short-skip signal strengths, high solar flux values have little effect. Geomagnetic disturbances, more evident at the equinoctial periods, cause signal attenuation and fading on polar paths. Noise increases noticeably on these lower frequency bands in the coming months. Please remember the DX windows.

Article J

HAM RADIO

Now receive or leave messages with other local hams using the 16K Bulletin Board featured on the smallest TNC available — the Heath® HK-21 Pocket Packet.

The BBS operates under your call with simple commands like **Send** or **Write** a message, **Kill** a message and read the **File** messages currently on the system. And the HK-21 Pocket Packet is fully TNC-2 compatible.

Hookup is easy. Plug in supplied cables instantly to most

HT's, or wire a separate cable into your mobile or base VHF or UHF rig. Connect your

computer via RS-232 and you're ready to call a fast-growing number of packet hams.

The HK-21 Pocket Packet requires only a single 12 VDC @ 40mA power source or as little as 29mA from an optional HKA-21-1, internally mounted 4.8 volt, 120 mAh, NICAD battery.

The Heath® HK-21 Pocket Packet — \$219.95 (Amateur net price)
To order, call 1-800-253-0570

For information on Heath's complete line of amateur radio products call 1-800-44-HEATH for your FREE Heathkit® catalog.

Best to start with.
Best to stay with.

Heath Company
Benton Harbor, MI 49022

Get your message across... even when no one is listening.



A subsidiary of Zenith Electronics Corporation.
©1989, Heath Company

DOWN EAST MICROWAVE



MICROWAVE ANTENNAS AND EQUIPMENT

• Loop Yagis • Power Dividers • Linear Amplifiers • Complete Arrays • Microwave Transverters • GaAs FET Preamps
• TROP • EME • Weak Signal • OSCAR • 902 • 1269 • 1296 • 2304 • 2400 • 3456 MHz

2345 LY	45el	loop Yagi	1296 MHz	20dBI	\$97
2345 LY	45el	loop Yagi	2304 MHz	20dBI	\$84
3333 LY	33el	loop Yagi	902 MHz	18.5dBI	\$97

Above antennas assembled and tested. Kits available.

Add \$8 UPS SH, \$11 West of the Mississippi

MICROWAVE LINEAR AMPLIFIERS SSB, ATV, REPEATER, OSCAR

2316 PA	1w in 18w out	1240-1300 MHz	13.8V	\$255
2335 PA	10w in 35w out	1240-1300 MHz	13.8V	\$305
3318 PA	1w in 20w out	900-930 MHz	13.8V	\$255
3335 PA	10w in 40w out	900-930 MHz	13.8V	\$305
23LNA	preamp 0.7dB N.F.	1296 MHz		\$ 80
33LNA	preamp 0.9dB N.F.	902 MHz		\$ 80

Add \$5 shipping UPS/48

LMW 1296 & 2304 MHz transverter kits in stock

Write for free catalog



DOWN EAST MICROWAVE
Bill Olson, W3HOT
Box 2310, RR 1, Troy, ME 04987
(207) 948-3741



THE MULTIPLE RECEIVER SOLUTION



4 Channel Signal-to-Noise Voter

- Expandable to 32 Channel by Just Adding Cards
- Continuous Voting
- LED Indicators of COR and Voted Signals
- Built-in Calibrator
- Remote Voted Indicators Pinned Out
- 4 1/2 x 6 Double Sided Gold Plated 44 Pin Card
- Remote Disable Inputs
- MORE

Built, tested and calibrated with manual

\$350.00

Telephone interface now available
For more information call or write:

DOUG HALL ELECTRONICS
Voter Department
815 E. Hudson Street
Columbus, Ohio 43211
(614) 261-8871

SYNTHESIZED SIGNAL GENERATOR

MADE IN USA



MODEL SG-100F
\$429.95 delivered

- Covers 100 MHz to 199.999 MHz in 1 kHz steps with thumbwheel dial
- Accuracy +/- 1 part per 10 million at all frequencies
- Internal FM adjustable from 0 to 100 kHz at a 1 kHz rate
- External FM input accepts tones or voice
- Spurs and noise at least 60 dB below carrier
- Output adjustable from 5-500 mV at 50 Ohms
- Operates on 12 Vdc @ 1/2 Amp
- Available for immediate delivery • \$429.95 delivered
- Add-on accessories available to extend freq range, add infinite resolution, AM, and a precision 120 dB attenuator
- Call or write for details • Phone in your order for fast COD shipment.

VANGUARD LABS

196-23 Jamaica Ave., Hollis, NY 11423
Phone: (718) 468-2720 Mon. thru Thu.

✓ 152

✓ 153

✓ 154

THE WEEKENDER



A transmit timer for the KPC-2

One of life's most embarrassing moments is finding your packet TNC has glitched and tied up a busy packet channel for several hours. My TNC, an older Kantronics KPC-2, doesn't have a transmitter time-out timer. Several circuits have been published as solutions to this problem, but I feel mine is a novel approach because it uses existing circuitry to incorporate a timer. You add only two diodes, a resistor, and a single capacitor.

The KPC-2 is a fine TNC, but as with many devices with internal microprocessors, erratic supply voltage fluctuations can cause the internal program to "crash" and the TNC to go into continuous transmit mode. Besides the embarrassment, you also run the risk of burning out your transmitter PA.

Before you start

All of the modifications are performed on the KPC-2 pc board. You should have some expertise doing minor pc board modifications before attempting this one. I also advise you to use a *grounded soldering station* and take the necessary precautions against static discharge. Your Kantronics warranty and factory service options may be adversely affected by this installation.

Opening the TNC

Remove the pc board through the front of the case. The bezel and front panel are held in place by two screws. Before you can slide out the board, you *must* remove the screw mounting the 7805 to the case.

By Peter J. Bertini, K1ZJH, 20 Patsun Road, Somers, Connecticut 06071

Attempting to slide the board forward before removing this screw will damage the regulator. Avoid disturbing the LED indicators or they won't mate with the panel cutouts during reassembly.

Timer length

Most packet operations require transmit times of 10 seconds or less. For file transfers, transmit times of 20 seconds or more are common. Some packet conference systems use TX times of up to a minute. Using a 100-k resistor value for R1 yields a 10-second time limit; a value of 560 k for R1 allows 60 seconds before time-out.

Preparing the board

Using your KPC manual pictorial layout, locate IC U14. This is a 74HC04 14-pin device. Locate pin 13 and carefully cut the trace to the pin on the solder side of the board. *Verify that you have the correct pin before cutting the run!*

Now install diode D2 and resistor R1 between pin 13 and Vcc (5-volt bus). Pin 14 of U14 is the Vcc supply for the chip. I elected to mount the diode on the solder side of the board, and tacked the resistor directly to the IC pins topside. *Observe diode polarity* — the cathode (bar) must go to pin 14!

Locate the solder pads for U13. This device is not used on the KPC-2. On the component side of the board you'll find two or three pads for U13 that are connected to the ground bus. Select one of these pads and carefully cut it free of the ground connection. Next prepare diode D1 and capacitor C1. You'll mount these components between pin 13 of U14 and the open pad on U13. Cut the leads to length and put spaghetti over the exposed leads before soldering. Again, note the polarity. The positive lead of C1 and the cathode (bar) of D1 must go to pin 13 of U14. There will be three leads connected to pin 13 of the IC at this point, so solder carefully! Now, trace the cut run from pin 13 of U14. You'll find it goes to one of two solder-through connections in the vicinity of U8. Solder a short piece of wire-wrap wire from this point back to the freed pad of U13, where capacitor C1 and diode D1 were terminated.

This completes the modification. Carefully recheck your work to be sure everything is right before you put the KPC-2 back together. Note that my pc board is version PC 35. Your KPC may use a different revision level, and have a different parts layout than mine.

Checking it out

Put your station back together and select a quiet packet frequency. Monitor your transmissions on another receiver. Select the calibrate mode for the TNC; refer to the manual if you're not familiar with this command mode. Your terminal will give you an R, T, or X prompt. Hitting the T key should key your transmitter. You'll hear a calibration tone on the monitor receiver if

the HAM STATION

P.O. Box 6522
220 N. Fulton Ave.
Evansville, IN 47719-0522

Store Hours
MON-FRI: 9AM - 6PM
SAT: 9AM - 3PM
CENTRAL TIME

SEND A SELF ADDRESSED STAMPED
ENVELOPE (SASE) FOR NEW AND USED
EQUIPMENT SHEETS

WARRANTY SERVICE CENTER FOR:
ICOM, YAESU, TEN-TEC

FOR SERVICE INFORMATION CALL
(812) 422-0252
MONDAY - FRIDAY
9:00 AM - 12:00 NOON

TERMS:

Prices Do Not Include Shipping.
Price and Availability Subject to
Change Without Notice

Most Orders Shipped The Same Day

COD's Welcome



FT-747GX

- 100 Watts of Economical Performance
- Dual VFO's, 20 Memories
- Receives from 100 kHz-30 MHz
- Built-in CW Filter + More



FT-212 RH

- 2 Meter Mobile
- Optional, Internal Digital Voice Recorder
- RX 138-174 MHz
- TX 144-148 MHz
- 45 Watts Output
- FT-712 RH Available for 70cm



IC-32AT

- New Dual Band HT
- RX-138-174 MHz 440-450 MHz
- TX-140-150 MHz 440-450 MHz
- 5 Watts Output on Both Bands
- Full Duplex & 40 Memories



IC-228A

- 25 Watt, 2 Meter FM Mobile
- RCV 138-174 MHz
- TX 140-150 MHz
- 20 Memories

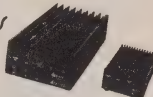


OMNI V

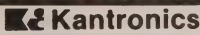
- New U/LSB, QSK, CW, FSK HF Rig
- Dual VFO's, 100 W Output
- Allbands 160-10
- Superior "Phase Noise"
- Made in USA



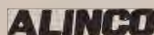
VHF/UHF AMPS



- High VSWR and Overdrive Protection
- 5 Year Warranty, 6 Months on RF Transistors
- All Units have GaAsFET Receive Pre-amps

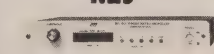
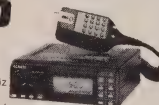


- Packet, WEFA, ASCII, AMTOR, RTTY, CW
- Simultaneous Operation on HF and VHF



ALD-24T

- Dual Band Mobile 140-149.995 MHz/ 440-450 MHz
- 21 Programmable Memories
- 25 Watts Output on Both Bands
- Loaded with Extra Features



MFJ-1278

- Multi-Mode Data Controller
- Packet, RTTY, ASCII, CW, WEFA, SSTV, Contest Memory Keyer

Orders and Price Checks Call **800-523-7731**

Indiana and Information
Call 1-812-422-0231

W6SAI BOOKS

published by Bill Orr, W6SAI and Stu Cowan, W2LX

BEAM ANTENNA HANDBOOK

Completely revised and updated with the latest computer generated information on BEAM Antenna design. Covers HF and Yagis and 10, 18 and 24 MHz WARC bands. Everything you need to know. 204 illustrations. 268 pages. ©1985. Revised 1st edition.

□ RP-BA Softbound \$11.95

ALL ABOUT VERTICAL ANTENNAS

Theory, design, construction, operation—are fully covered. Here's what this exciting book covers: Horizontal vrs vertical—which is best? Top loaded and helical antennas, 5 high efficiency Marconi antennas for 80 and 160, verticals and TVI—is there a problem? The effects of ground on vertical antennas and a how to make an effective ground system, the Bobtail beam, construction data for 25 different antennas, matching circuits of all descriptions—which is best, plus P-L-E-N-T-Y more! 1st edition, 192 pages © 1986

□ RP-VA Softbound \$10.95

RADIO HANDBOOK 23rd Edition

Here are some of the highlights of this exciting new edition: New easy-to-use charts for Chebyshev and elliptic filter configurations, new data on power MOS-FETs, how to use state-of-the-art OP-AMPS, and home computer RTTY to name just a few examples. New projects include: GaAsFET preamps for 902 and 1296 MHz, easy-to-build audio CW filter, Economy two 3-5002, 160 meter amplifier, multiband amp using two 3CX800A7's, and a deluxe amplifier with the 3CX1200A7 tube. New antenna projects include: efficient Marconi design for 160 and 80 meters, computer generated dimensions for HF-Yagis, and a 2 meter slot beam. Get your copy today. 23 edition © 1986

□ 22424 (Reg. \$29.95) Hardbound \$26.95

THE RADIO AMATEUR ANTENNA HANDBOOK

A wealth of projects that covers verticals, long wires, beams as well as plenty of other interesting designs. It includes an honest judgement of gain figures, how to site your antenna for the best performance, a look at the Yagi-Quad controversy, baluns, slopers, and delta loops. Practical antenna projects that work! 190 pages. ©1978. 1st edition.

□ RP-AH Softbound \$11.95

Please enclose \$3.50 for shipping and handling.



HAM RADIO

GREENVILLE, NH 03048

BOOKSTORE

(603) 878-1441

HAM RADIO SHIRTS and HATS GREAT Gift Ideas!

Here's a great way to say you're a HAM RADIO reader. Get a hat with your name and call and wear your HAM RADIO Magazine shirt!



Baseball Caps come in gold, blue, red and kelly green. Please give us the name and call sign you want lettered on the hat (maximum of 6 characters per line.)
UFBC (comes in gold, blue, red, kelly green)\$5.95



HAM RADIO shirts come in two attractive styles. The TEE shirt is great for general everyday use. The HAM RADIO polo is for a more formal occasion. Each shirt is made of a 50/50 blend and comes in either blue or red. The new HAM RADIO logo is silk-screened in a vibrant yellow color on the front of each shirt.

Sizes Available:
S, M, L, XL

HR-TEE B (blue) R (red).....\$ 9.95
HR-PLO B (blue) R (red).....\$19.95

Please enclose \$3.50 to cover shipping and handling.



HAM RADIO

GREENVILLE, NH 03048

BOOKSTORE

(603) 878-1441

February 1989 **77** 95

FIGURE 1

The diagram shows a circuit for a 100-msec delay. A block labeled U8 is connected to the input (pin 13) of a 7414 hex inverters (U14). The output (pin 12) of U14 is connected to the base of a 2N2222A transistor (Q3) through a resistor R39. The emitter of Q3 is grounded, and the collector is connected to a positive supply rail.

FIGURE 2

Diode D1 and D2 1N914 or equivalent
 Capacitor C1 150 μ F, 6 volts electrolytic
 Resistor R1 100 to 560 k, 1/4 watt (see text)

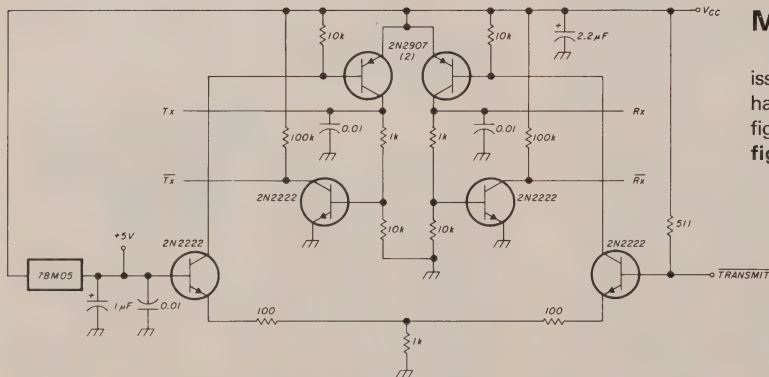
everything's working correctly. Hitting the R key should immediately drop the transmitter. Toggle back and forth between the R and T keys several times to confirm that the TNC is keying and unkeying the radio properly. Now select the T key and wait — the TNC should time out eventually. After time-out, immediately hit the R and T keys again. The transmitter should come back on until

Theory of operation

In the modified circuit, capacitor C1 is normally discharged. During transmit, the negative lead of C1 is brought low. The charging current for C1 maintains a low state on pin 13 of U14, until C1 reaches a charge voltage equal to the threshold of pin 13 on U14. The value of R1, in conjunction with the source current provided by the inverter input, and the value of C1 determine the actual time interval before time-out. D1 forces an immediate high level to the inverter when going to receive. Diode D2 provides a discharge path for C1 during the receive state; this prevents consecutive packet exchanges from causing a cumulative time-out. I suspect this circuit might be adaptable to other TNCs, although I haven't investigated that possibility. Purists may wish to include a small resistor, under 100 ohms, in series with C1 to limit the inrush current on pin 15 of the microprocessor.

HAM RADIO

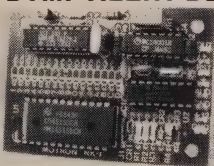
short circuit



Missing figure

Please note that in the October 1988 issue, **fig. 7** shown on page 26, should have been included in **fig. 9**. The figure shown here should have been **fig. 7** in Part Three of N6GN's article.

NET-KALL NK-1 DTMF ALERT DECODER



From
Only
\$34.95!

- Momentary or latched output
- Multiple Group-Call response
- High stability xtal controlled SSI-202
- Ideal for an economical alert system



NK-1K (kit) **\$34.95**

NK-1W (Wired/Tested) **\$44.95**

(Add \$2.00 Shipping/Handling in U.S.A.)

MoTron Electronics

Call Toll-Free

695 W. 21st Ave.

1-800-338-9058

Eugene, OR 97405

or (503) 687-2118

✓ 155

THE RF CONNECTION

"SPECIALIST IN RF CONNECTORS AND COAX"

Part No.	Description	Price
321-11064-3	BNC 2 PST 28 volt coaxial relay, Amphenol Insertion loss: 0 to 0.75GHz, 0.10dB Power rating: 0 to 0.5GHz, 100 watts CW, 2 kw peak Isolation: 0.1 GHz/45db, 0.2 GHz/40db, 0.4 GHz/35db	\$25 used tested
83-822	PL-259 Teflon, Amphenol	1.50
PL-259/ST	UHF Male Silver Teflon, USA	1.50
UG-21D/U	N Male RG-8, 213, 214, Amphenol	2.95
UG-21B/U	N Male RG-8, 213, 214, Kings	4.00
9913/PIN	N Male Pin for 9913, 9086, 8214 fits UG-21D/U & UG-21B/U N's	1.50
UG-21D/9913	N Male for RG-8 with 9913 Pin	3.95
UG-21B/9913	N Male for RG-8 with 9913 Pin	4.75
UG-146/U	N Male to SO-239, Teflon USA	5.00
UG-83/U	Female to SO-239, Teflon USA	5.00

"THIS LIST REPRESENTS ONLY A
FRACTION OF OUR HUGE INVENTORY"

THE R.F. CONNECTION
213 North Frederick Ave. #11
Gaithersburg, MD 20877

(301) 840-5477

VISA/MasterCard: Add 4%

Prices Do Not Include Shipping

✓ 156

KeproClad

by Kepro Circuit Systems, Inc. T.M.

The Power and The Glory

1-800-325-3878

1-314-343-1630 MO

For the dealer nearest you.



Kepron Circuit Systems, Inc.

Make PCB's In Your Home!

KepronClad™ gives you the *power* to produce industrial quality printed circuit boards at home. PCB's you can use for nearly any electronic construction project — from simple power supplies to sophisticated lasers. And when you're done, you'll know the *glory* that comes from top performance assured by the use of KepronClad PCB's.

KepronClad is the quick, easy and inexpensive system for production of quality printed circuit boards. KepronClad has all the supplies and instructions you need to create professional boards at home.

All KepronClad products are safe, easy to use and come with an unconditional guarantee. When you want to build the best, choose KepronClad. KepronClad gives you the power. You get the glory.

For your free KepronClad catalog and name of the KepronClad dealer nearest you, call Kepron.

630 Axminster Drive, Fenton, MO 63026-2992

✓ 157



ICOM



✓ 158

VHF COMMUNICATIONS

9:00 am - 5:30 pm
weekdays

Weekends and evenings
by appointment.

ICOM, AEA, LARSEN, VAN GORDEN,
VIBROPLEX, NYE-VIKING, FALCON
COMM, LEADING EDGE, ARRL PUBLI-
CATIONS, KAGLO, HAMTRONICS, ETC.

280 Tiffany Avenue
Jamestown, New York 14701

Western New York's finest... amateur radio dealer!

PH. (716) 664-6345

Sparky J. Antennas

• Install Fast • Extend Range • Improve Reception •
The Sparky J. Antenna is a flexible half wave radiator fed by 1/2 wavelengths of low loss coax through an efficient linear matching transformer. Sparky J's beat duckies, 1/4 & 5/8 wave antennas, need no ground plane. Low flat SWR curve gives edge to edge band coverage. Great portable—rolls up to fit in pocket. Completely assembled with BNC connector.
• Easily hidden • Effective indoors or out • Money-back guarantee •
Available for every band from 50 to 440 MHz
\$39.95 each Two for \$65.00 Add \$5 P & H
AntennasWest
Box 50062-H, Provo, UT 84605 (801) 373-8425

✓ 128

NEW NEW NEW

PLENTY OF BOOKS LISTED IN THE BOOK-
STORE'S CATALOG—

SAVE TIME AND MONEY.

SHOP BY MAIL FROM OUR #1 SOURCE
OF AMATEUR BOOKS AND SOFTWARE.

HAM RADIO'S BOOKSTORE GREENVILLE, NH 03048
(603) 878-1441

1989 U.S. CALL DIRECTORY (on microfiche)

Call Directory - by callsign\$8

Name Index - by last name\$8

Geographic Index - by state/city\$8

All three - \$20

\$3 shipping per order

BUCKMASTER PUBLISHING

Route 3, Box 56

Mineral, Virginia 23117

703/894-5777 visa/mc 800/282-5628

✓ 159



Flea Market

RATES Noncommercial ads 10¢ per word; commercial ads 60¢ per word both payable in advance. No cash discounts or agency commissions allowed.

HAMFESTS Sponsored by non-profit organizations receive one free Flea Market ad (subject to our editing) on a space available basis only. Repeat insertions of hamfest ads pay the non-commercial rate.

COPY No special layout or arrangements available. Material should be typewritten or clearly printed (not all capitals) and must include full name and address. We reserve the right to reject unsuitable copy. **Ham Radio** cannot check each advertiser and thus cannot be held responsible for claims made. Liability for correctness of material included to corrected ad in next available issue.

DEADLINE 15th of second preceding month.

SEND MATERIAL TO: Flea Market, Ham Radio, Greenville, N. H. 03048.

BEGINNER'S RADIO CLEARINGHOUSE. On a space available basis, we are going to offer you, OUR SUBSCRIBER, free of charge, a chance to find a home for your used equipment with a new Ham. Please send us a short description of what you want to sell along with price, name, address and phone number. We'll run it once in a special section of the classified ads under the heading of BEGINNER'S RADIO CLEARINGHOUSE. Please limit your ad to 20 words or less.

GOOD BEGINNER RIG. Heath SB-101 transceiver with HP-23 supply, SB-600 speaker, CW filter, extra tubes, manual \$250. Contact WA7GVT (406) 365-2261.

NATIONAL Radio Manual and NCL-2000 factory parts lists. SASE. Mac Fuchs, 11 Plymouth Lane, Swampscott, MA 01907.

ELECTRONIC KITS & ASSEMBLIES. For our latest catalog send SASE (45 cents) to: A & A ENGINEERING, 2521 W. LaPalma, #K, Anaheim, CA 92801.

IBM-PC SOFTWARE FOR PK-232. New CompRtty II/PC is the complete communications program for the PK-232/HK-222. Uses host mode of PK-232 for complete control. Text entry via built-in screen editor! Adjustable split screen display, including optional Triple Split (TM) in Packet mode. Instant mode/speed change. Hardcopy, diskcopy, break-in buffer, select calling, text transfer, customizable full screen logging, 24 programmable 1000 character messages, mailbox facility. Ideal for MARS and traffic handling. Requires 256K PC compatible. \$65. Non-PK-232 version still available. Send call letters (including MARS) with order. David A. Rice, KC2HO, 144 N. Putt Corners Rd, New Paltz, NY 12561.

GROUND RADIAL WIRE for verticals or slopers. Improves performance. New #16 bare solid copper. LOWEST COST, 1000 foot spool, \$38 includes shipping. DAVIS RF, PO Box 230-H, Carlisle, MA 01741. (508) 369-1738.

COMMODORE/AMIGA chips, (eg. 6510—\$11.55, 6526—\$12.50, 6567—\$19.95, 6581—\$13.85, PLA/82510—\$14.75, 901 ROM series—\$11.50), parity diagnostics, hard to find items. Authorized service center. Fast repairs, low cost (eg. C64-\$49.49 plus UPS). Heavy duty power supplies for the C64-\$28.00 plus UPS. KASARA MICROSYSTEMS, (Division of OEP), Rt. 9W/Kay Fries Drive, Summit Point, NY 10980. 1-800-248-2983 (outside NY) or 914-942-2252.

COMPUTER CODE COURSE: Apple II + c/e/GS. C-64/128. 37 modes, graphics, 1-100 WPM, menus, proportional spacing, variable frequency, more (\$29.95). With micro processor (\$39.95). Manual (\$10). Check, MO. LARESCO, PO 2081-HR, Calumet City, IL 60409. 1-312-891-3279.

UHF PARTS. GaAs Fets, mmics, chip caps, feedthrus, teflon pcb, high Q trimmers, Moonbounce quality preamps. Electronic sequencer boards. Send SASE for complete list or call (313) 753-4581 evenings. MICROWAVE COMPONENTS, PO Box 1697, Taylor, MI 48180.

KITS 'PARTS' PLANS. We have hard to find parts! Variable tuning capacitors, tuning coils, crystal and magnetic headphones, germanium diodes, crystal, shortwave and tube type kits. Very inexpensive. Send 25 cent stamp for catalog. Yeary Communications, 12922 Harbor #600HR, Garden Grove, CA 92640.

\$50 PACKET Digicom 64—software based PACKET system for Commodore 64. Software is public domain and requires a modem for the 64 which is provided by our kit. Board plugs directly into cassette port or remote mounted via cable, both connectors included. Watchdog timer, read relay PTT and PTT inversion options included. Powered down from computer. Uses 7910 chip—no alignment required. Switch allows HF or VHF operation. Order Kit #154 for \$49.95 or Assembly #154 for \$79.95 both include FREE DISK. Add \$2.50 s/h. A & A ENGINEERING, 2521 W. LaPalma #K, Anaheim, CA 92801. (714) 952-2114. MC or VISA accepted.

DIGITAL AUTOMATIC DISPLAYS. Any Radio. Be specific. GRAND SYSTEMS, POB 2171, Blaine, WA 98230.

QUALITY HAM SOFTWARE for the IBM-PC and compatibles. Many shareware and public domain disks for all aspects of ham radio. Business SASE for catalog. JK&S Dept HE, PO Box 50621, Indianapolis, IN 46250-0521.

MAGAZINES WANTED: "Microwave Systems News" (MSN), "RF Design", "PCIM (Power Conversion & Intelligent Motion)" and "OEX" (1980-present). Call collect 519-742-4594 (Ontario) after 6 PM Eastern time.

IMRA International Mission Radio Association helps missionaries. Equipment loaned. Weekday net, 14,280 MHz, 1-3 PM Eastern. Nine hundred Amateurs in 40 countries. Rev. Thomas Sale, S.J., University of Scranton, Scranton, PA 18510.

MACINTOSH Ham Software. MacTrack™ tracks satellites, sun, moon, graphic or tabular outputs. Compatible with Mirage Tracking interface for rotor control, \$59.95. DX Helper™ provides DX info including distance, bearing, sunrise, sunset, propagation MUF, great circle display, more, \$34.95. SASE for info from R. Stegmeyer, PO Box 1590, Port Orchard, WA 98366.

BACK ISSUES OF HAM RADIO. Have most issues from 1969 to 1974. Mint condition. \$3.00 for single issues. VN0G, 319-377-3563.

MICROWAVE GENERATORS: All checked, working: HP-626A, HP-628A, HP-8690A sweep gen, \$150/ea. FXR L772A 1-2 GHz, \$75. GR-1218A 1-2 GHz, GR-1021A VHF/Gen 40-250 MHz, \$100/ea. GR-1014A VHF bridge \$125. Also test equipment: HP-410C meter w/out probe, \$100. GR-1611A capacitance bridge \$100. GR-650A impedance bridge, \$55. All plus: Tektronix 1908 generator; C-27 camera; type-82; type-M plug-in units; measurements 188 FM/Gen; Sorenson SCS268-8 DCPS, 10, 40, 80amps, Var/Reg, metered; Alfred HVPS-2-3.5KV, 23mA, Var/Reg, metered; Heath UE-205 2-Pen Chart Recorder Hi-Sens w/access; GR-1672A Digital System Control; Theta Resolver Test; Military SRR-11 VLF receiver 14-600 kHz. All \$35; GR-1604A, Krohn-Hite 330A Var/Lab Bandpass Filter; HP-412A DC-VOM; HP-130C; HP-416A Ratometer; Ballantine 360 DVM w/TRMS. Also H-V Plate Transformers, 4400V/CT 235mA; 3500V/CT 275mA, \$75/ea. Giant Powerstat 220V/28A, 0-280V, 7.8kVA \$145. SASE list. Joseph Cohen, 200 Wabasha, Winthrop, MA 02152. 617/846-6312.

ANTENNA PARTS AND CATALOG. Lowest costs. Dipole/Quad/ground radial wire, insulators, center feeds, open wire feed line, coax, relays, #14 multistrand dipole/wire quad, non-feed line, very flexible, \$34 per 275' (minimum), \$12/ft. there after, includes shipping. Catalog \$2.00. DAVIS RF, PO Box 230-H, Carlisle, MA 01741. (508) 369-1738.

HAM TRADER YELLOW SHEETS. In our 27th year. Buy, swap, sell ham radio gear. Published twice a month. Ads quickly circulate—no long wait for results. Send NO. 10 SASE for sample copy. \$13 for one year (24 issues). PO Box 2057, Glen Ellyn, IL 60138-2057 or PO Box 15142, Dept HR, Sattle, WA 98115.

VHF/UHF-SHF. Large SASE. West Coast VHFer, POB 685, Holbrook, AZ 86025.

CHASSIS & CABINET KITS. SASE. K3WIK, 5120 Harmony Grove Rd, Dover, PA 17105.

ANALOG AND RF CONSULTING for the San Francisco Bay area. Commercial and military circuits and systems. James Long, Ph.D., N6YB (408) 783-8239.

RTTY JOURNAL—Now in our 36th year. Read about RTTY, AMTOR, packet, MOS's, RTTY controlling, RTTY DX and much more. Year's subscription to RTTY JOURNAL \$10.00. Foreign slightly higher. Order from: RTTY JOURNAL, 9085 La Casita Ave., Fountain Valley, CA 92708.

WANTED: Hammarlund H0170AC vhf, and H0180AC, prefer Mint Cond. Mike Match, PO Box 515, Cedar Ridge, CA 95924. (916) 477-0622.

RUBBER STAMPS: 3 lines \$5.00 PPD. Send check or MO to G. L. Pierce, 5521 Birkdale Way, San Diego, CA 92117. SASE brings information.

CASH OR TRADE for all types of transmitting or special purpose tubes. M & S COMMUNICATIONS ENGINEERING 160 So. Auburn Street, Suite 200, Grass Valley, CA 95945. (916) 272-5500.

ELECTRON TUBES: Receiving, transmitting, microwave... all types available. Large stock. Next day delivery, most cases. QUALI ELECTRONICS, PO Box 5029, Compton, CA 90224. (213) 774-1255.

MOTOROLA MAXAR 80. 800 MHz 2-way w/mike/PL. Good condition \$250. Heathkit 20 SSB module \$125. Hallicrafter SX141 \$125. Bob Shurman, 729 S. Chocoley, Clawson, MI 48017.

EXPLORE the license free 160-190 kHz band. Communications over 100 miles. Free information and our kit will help you get on the air fast! Send stamp for brochure to: SEDEN COMMUNICATIONS, 1272 Harold Avenue, Simi Valley, CA 93065

WANTED: ARC-5 and SCR-274 equipment, parts and accessories in any condition. Ken WB9OZR, 362 Echo Valley, Kinnelon, NJ 07405. (201) 492-9319.

WANTED: Ham equipment and other property. The Radio Club of Junior High School 22 NYC, Inc. is a nonprofit organization, granted 501(c)(3) status by the IRS, incorporated with the goal of using the theme of Ham Radio to further and enhance the education of young people. Your property donation or financial support would be greatly appreciated and acknowledged with a receipt for your tax deductible contribution. We sponsor the classroom net on 7.238 at 1200 UTC daily and encourage your QSL for our weekly award. Please write us at: PO box 1052, New York, NY 10002 or call our round the clock hotline: (516) 674-4072. Thank you!

CLEANING OUT LIBRARY. Send SASE for big list of ham radio and electronic books and magazines (HR, QX, 73, QST, Wireless World, Popular Electronics, etc.). Joe Holstein, N8EA, 1515 Sashabaw, Ortonville, MI 48462.

CUSTOM MADE EMBROIDERED PATCHES. Any size, shape, colors. Five patch minimum. Free sample, prices and ordering information. HEIN SPECIALTIES, Inc., Dept 301, 4202 N. Drake, Chicago, IL 60618.

RECONDITIONED TEST EQUIPMENT \$1.25 for catalog. Walter, 2697 Nickel, San Pablo, CA 94606.

SCHOLARSHIP. The Dayton Amateur Radio Association is now accepting applications for its 1989 Scholarship Program. The program is open to any licensed Amateur graduating from high school in 1989. For information and application forms write Scholarship Committee, 317 Ernst Avenue, Dayton, OH 45405.

COMING EVENTS

Activities — "Places to go . . ."

SPECIAL REQUEST TO ALL AMATEUR RADIO PUBLICITY COORDINATORS: PLEASE INDICATE IN YOUR ANNOUNCEMENTS WHETHER OR NOT YOUR HAMFEST LOCATION, CLASSES, EXAMS, MEETINGS, FLEA MARKETS, ETC. ARE WHEELCHAIR ACCESSIBLE. THIS INFORMATION WOULD BE GREATLY APPRECIATED BY OUR BROTHER/SISTER HAMS WITH LIMITED PHYSICAL ABILITY.

KENTUCKY: February 11, Ham Radio & Computer Fest, Cave City Convention Center, Cave City. Setup 6 AM. Doors open 8 AM. Admission \$3/advance. DX, Packet, Antennas forums. VE exams. Activities for the entire family. Talk in on 145.410 or 146.52.

MICHIGAN: The Cherryland ARC's 16th annual Swap-N-Shop, East Bay Elementary School, 3962 Three Mile Road N., Travelers Rest, 8 AM to 2 PM. Admission \$3.00. Tables \$6.00. Talk in on 146.850 repeater. Free information Mike Hubbard, N8BY, 5772 Vance Road, Interlochen, MI 49643. (616) 276-9143.

OHIO: February 12, The Mansfield Mid-Winter Hamfest/Computer Show, Richland County High School, Mansfield. Doors open 7 AM. Tickets \$3/advance; \$4/door. Tables \$6/advance; \$8/door. For additional information, tickets or tables SASE to Dean Whisenand, KB8MG, 1094 Beal Road, Mansfield, Ohio 44905 (419) 589-2415 after 4 PM EST.

COLORADO: February 19, The Aurora Repeater Association's 8th annual Swapfest, Jefferson County Fairgrounds, 15200 W. 6th Avenue, Golden, 8 AM to 3 PM. For information contact Jit, W0DHPN (303) 846-1413 or Jan, KA7TYU, PO Box 3666, Denver, CO 80239.

MINNESOTA: February 25, Midwinter Madness Hamfest, Medina Ballroom, Medina. 7 AM to 2 PM. Admission \$3/advance; \$5/door. For information contact Dennis Pollard, K201. (612) 355-7189 evenings.

FLORIDA: February 25, The 7th annual Hernando County Hamfest, Hernando County Fairgrounds Auditorium, US 41 South (4 miles south of Brooksville). Doors open 8 AM. Advance registration \$2.00; at the door \$3.00. Swap tables \$8.00. Free parking. Overnight parking permitted. No facilities. For advance registration SASE to Hamfest Chairman, PO Box 1721, Brooksville, FL 34605.

SOUTH CAROLINA: February 25, The Charleston Amateur Radio Society's annual Hamfest, National Guard Armory, 89 Hagood Avenue, Charleston. For information E. Skies, N4LS, 16 Trumbo Street, Charleston, SC 29401 or call (803) 723-4000.

TEXAS: February 25, The Orange ARC's 4th annual Hamfest-Flea Market, National Guard Armory Building, Meeks Drive, Orange, 9 AM to 5 PM. Setup time 7 AM. Tables \$4.00. Dealers \$10. Talk in on 147.180.

GEORGIA: February 25. The Dalton ARC's annual Hamfest, North Georgia Fairgrounds. For information write DARCI, POB 143, Dalton, GA 30722-0143. Or contact members via GA cracker net or GA SSB net.

OHIO: February 25 and 26. ARRL Ohio section convention, Cincinnati Gardens Exhibition Center, Langdon Farm Road and Seymour Avenue, Cincinnati. 8:30 to 5 both days. For information contact Stan Cohen, W0RQDQ, 2301 Royal Oaks Ct., Cincinnati, Ohio 45237. (513) 531-1011.

INDIANA: February 26. The LaPorte ARC's Hamfest, LaPorte Civic Auditorium. Admission \$3.50. Reserved tables \$3. Talk in on 146.520 or 146.610 with PL of 131.8. Contact SASE LPARC, PO Box 30, LaPorte, IN 46350.

OHIO: February 26. The Cuyahoga Falls ARC's 35th annual Hamfest, Akron North High School, 8 AM to 2 PM. Tickets \$3/advance; \$4/door. Reserved tables \$5. Or bring your own. For information Bill Sovinsky, KBJSJ, 2305—24th Street, Cuyahoga Falls, OH 44223. (216) 923-3830.

VIRGINIA: February 26. Vienna Wireless Society's Winterfest. Vienna Community Center, 120 Cherry Street, Vienna. Setup 6 AM. General public 7:30 AM. Admission \$4/door; \$7/tailgate. Talk in on K4HTA/R 146.085/146.685 or W4LBL/R 146.190/146.790. For information Harry Kalkikian, W4ACN, 4941 Andrea Avenue, Annandale, VA 22003.

MICHIGAN: February 26. The 19th annual Livonia ARC's Swap 'n Shop, Dearborn Civic Center, Dearborn, 8 AM to 4 PM. ARRL/VEC exams. Free parking. Talk in on LARC Repeater 144.75/35 and 146.52. For information SASE to Neil Coffin, W4SGWL, Livonia ARC, POB 2111, Livonia, MI 48151.

KENTUCKY: March 4. The 13th annual Glasgow Swapfest, Cave City Convention Center, Cave City. Sponsored by the Mannmoth Cave ARC. 8 AM to 7 PM. Admission \$3. Tables \$3. Flea market. VE exams. Talk in on 146.34/94. For additional information N4HCO, 1379 Whitties Chapel Road, Glasgow, KY 42421.

TEXAS: March 4 and 5. South Texas Amateur Repeater Society Hamfest, Casa de Amistad (Civic Center) on Fair Park Blvd, Harlingen, Saturday 9-4. Sunday 9-2. Flea market. VE exams RACES/ARES meeting, ARRL forum and more. Talk in on 147.99/39 English. 146.10/70 Spanish. Admission \$5/advance; \$6/door. Tables \$7/advance; \$10/door. For information K5RAV, 2210 S. 77th Sunshine, Harlingen, TX 78550. (512) 425-7744.

PENNSYLVANIA: March 5. The 2nd annual York Springfest (Ham & Computer), Dover Firehall, York. Free tailgating, outdoor tables \$10. Registration \$4. Unlicensed spouse and under 12 free. VE exams. General admission 9 AM. Talk in on 146.37/97 and 147.93/33. For information and registration (301) 238-3878 or write YORK Springfest, PO Box 50, Shrewsbury, PA 17361-0050.

PENNSYLVANIA: March 5. The Two Rivers ARC's Hamfest, Rostrevor Fire Hall, PA 51, McKeesport. 8 AM to 3 PM. Admission \$1.00 at door. Full table \$6. Half table \$4.00. Talk in on 146.13/73, W43PBD/R Repeater. For information Louis H. Zimmerman, N3GJP, 911 Roland Road, Wilkins Twp, PA 15221. (412) 351-1562 10 AM to 10 PM.

MASSACHUSETTS: March 5. Mt. Tom Amateur Repeater Association Amateur Radio and Electronics Flea Market, Smith Vocational School, Rt.9, Northampton. Setup 7 AM. Doors open 9 AM to 2 PM. Admission \$2. Under 12 free accompanied by adult. Tables \$10/advance; \$12/door. VEC walk-in exams. Talk in on 146.94. 223.82 and simplex 146.52. Handicapped parking and access. Reservations: Bob, WB1E0G (413) 532-6411 days. Mickey, N1CDR (413) 562-1027 evenings. Or write MTARA Flea Market, 6 Laurel Ter, Westfield, MA 01085.

NEW JERSEY: March 12. The Delaware Valley Radio Association's 17th annual HAMCOMP '89, New Jersey National Guard 112th Field Artillery Army, Eggerts Crossing Road, Lawrence Township. 8 AM to 2 PM. Admission \$3/advance; \$4/door. Indoor spaces \$7 and \$10. Outdoor \$6. Sales bring your own tables. Setup 6 AM. Public 8 AM. Talk in on 146.07. 67. For information and space reservations write HAMCOMP '89, c/o KB2ZY, RD 1, Box 259, Stockton, NJ 08559. Please SASE. Handicap parking and wheelchair accessible.

INDIANA: March 12. The Morgan County Repeater Association's Indiana Hamfest, Indiana State Fairgrounds Pavilion Building, Indianapolis. Starts 8 AM. Admission \$5. 8' tables \$8. Free parking. VE exams. Talk in on 146.25. For information or table reservations SASE before 2/24/89 to Allen Scalapala, K2C9A, 3142 Market Place, Bloomington, IN 47403. (813) 339-4446.

FLORIDA: March 18 and 19. The Playground ARC's 19th annual North Florida Ham/Swapfest, Shrine Fairgrounds, North Ft. Beach. Doors open 8 AM both days. Admission \$3/advance; \$4/door. Tables \$10 one day or \$15 for both days. Flea market, exhibits, ARRL, MARS and OCWA meetings. Saturday night banquet. Free parking. RV parking \$10 with hook-up. Talk in on 146.79 and 52. For information write PARC, PO Box 873, Ft. Walton Beach, FL 32548.

ILLINOIS: March 19. The Sterling-Rock Falls ARS 29th annual Hamfest, Sterling High School Field House, 1608 Fourth Avenue, Sterling. Doors open 7:30 AM. Tickets \$3/advance; \$4/door. Dealers, large flea market, VE exams. Talk in on 146.25/146.85 W9MPE Repeater. For information, tables or tickets contact Sue Peters, PO Box 521, Sterling, IL 61081 or call AC (815) 625-9262.

NEW JERSEY: April 15. "Flemington Hamfest 89", sponsored by the Cherryville Repeater Association, 8 AM in the Hunterdon Central High School Field House. Admission \$4 advance, \$5 door. Children under 12 and XYLs free. Refreshments available from 6:30 AM. Advance tickets: Dave Hickson, K0ZRC, South Main St., Lakehurst, NJ 08530. Table/Mary Mary Grozinski, N5ZK, 6 Kirkbridge Rd., Flemington, NJ 08822. Information: (201) 788-4080 before 11 PM EST. VE testing begins at 10 AM, send FCC form 610, photocopy of current license, and a check for \$4.75 (payable ARRL/VEC) to: Cherryville Repeater Association, VE Test Team, Box 308, Quakertown, NJ 08908. Talk in: 146.52, 147.975/375, 146.615/015, 222.32/224.12 and 449.85/444.85 MHz.

DAYTON HAMVENTION: April 28, 29, 30.

When performance & price really count...



CRYSTEK CRYSTALS
The pulse of dependable communications

QUARTZ CRYSTALS FOR Industrial Equipment/Instrumentation


- Micro-processor control
- Computers/Modems
- Test/Measurement
- Medical

General Communications

- Channel element Service (VHF/UHF)
- Land Mobile 2-way
- Marine
- Aircraft
- Telemetry
- Monitors/Scanners/Pagers

Amateurs/2-Meter/General Coverage CB/Hobbyists/Experimenter


NEW



For Optimum Stability and Reliability in Frequency Management

Custom Made Crystals Catalog

CRYSTEK CORPORATION
DIVISION OF WHITEHALL CORPORATION



2351/2371 Crystal Drive • Ft. Myers, FL 33907
P.O. Box 06135 • Ft. Myers, FL 33906-6135
TOLL FREE 1-800-237-3061
PH 813-936-2109/TWX 510-951-7448/FAX 813-939-4226
TOLL FREE IN THE U.S.A. EXCEPT FLORIDA, ALASKA, HAWAII

Replacement Crystals Catalog

The Pulse of Dependable Communications...

Crystal Crystals offers their new 16 page FREE catalog of crystals and oscillators. Offering state of the art crystal components manufactured by the latest automated technology. Custom designed or "off the shelf," Crystek meets the need, worldwide. Write or call today!

OPERATING EVENTS

"Things to do . . ."

AMATEUR RADIO DAY. February 25. Hams will call all nations from Official Center of the World. A special event station, WA6BEZ, will be set up for one day and manned by licensed volunteers from the Yuma Amateur Radio Emergency Service. For more information contact, K0CKV, Yuma ARS.

AMATEUR RADIO CLASSES: For those people interested in obtaining a Novice (basic level) Ham license or upgrading to Tech/General, the Chelsea Civil Defense, in cooperation with QRA Radio Club, will sponsor Amateur Radio Communications classes evenings at Chelsea High School starting MARCH 7, 1989. For more information write Frank Masucci, K1BPN, 136 Grove Street, Chelsea, MA 02150. Please enclose your telephone number.

THE MIT UHF REPEATER ASSOCIATION and the MIT Radio Society offer monthly HAM EXAMS. All classes Novice to Extra. Wednesday, February 15, 7 PM, MIT Room 1-150, 77 Mass Avenue, Cambridge, MA. Reservations requested 2 days in advance. Contact Ron Hoffmann at (617) 484-2098. Exam fee \$4.50. Bring a copy of your current license (if any), two forms of picture ID, and a completed form 610 available from the FCC in Quincy, MA (617) 770-4023.

INTERNATIONAL RADIO AND COMPUTER, INC. ANNOUNCES



It is the newest ICOM dealer in the South East.

- We stock a complete line of ICOM radios and accessories.
- We guarantee the reliability of everything we sell with a complete performance and function check.
- We offer complete and efficient service of all our ICOM and other quality products with Factory Service parts.
- We have been servicing the amateur radio community for eight years and have 1000's of satisfied customers across the country.

Call us for a quote before you make your next ICOM purchase.

(407) 879-6868

Send for our FREE catalog including KENWOOD, YAESU and our complete line of radio and computer accessories.

INTERNATIONAL RADIO AND COMPUTERS, INC.

751 South Macedo Blvd.
Port St. Lucie, FL 34983





SAVE TIME and MONEY with THE HAZER

Bring things down for safety and convenience.

Never climb your tower again with this elevator system. Antennas and rotator mount on HAZER, complete system travels tower in vertical upright position. Safety lock system operates while raising or lowering. Never can fall.

Complete kit includes winch, 100 ft. of cable, hardware and instructions. For Rohm 20 and 25 G Towers.

Hazer 2-Heavy duty alum. 12 sq. ft. load	\$311.95 ppd.
Hazer 3-Standard alum. 8 sq. ft. load	\$223.95 ppd.
Hazer 4-Heavy galv. steel 16 sq. ft. load	\$291.95 ppd.

NEW for ROHN 45 and 55 Towers

Hazer 8-Heavy duty galv. steel 16 sq. ft. load	CALL
Ball Thrust Bearing TB-25 for any of above	CALL FOR PRICE

Send for free details of aluminum towers specifically engineered for use with the Hazer. Two sizes: M-13 (13' wide) and M-18 (18' wide). All bolted construction, no welds. Easy to install hinge base, walk up erection. Complete tower UPS or air freight shippable. Pre-assembled or kit form.

Satisfaction guaranteed. Call today and charge to Visa, MasterCard or mail check or money order.

GLEN MARTIN ENGINEERING INC.
Rte 3, Box 322
Boonville, MO 65233
(816) 882-2734 FAX 816-882-7200

ASSOCIATED RADIO

8012 CONSER BOX 4327
OVERLAND PARK, KANSAS 66204

VISA-MC
AMEX-DISC.



EVERY DAY A HAMFEST

BUY — SELL — TRADE
ALL BRANDS NEW AND RECONDITIONED



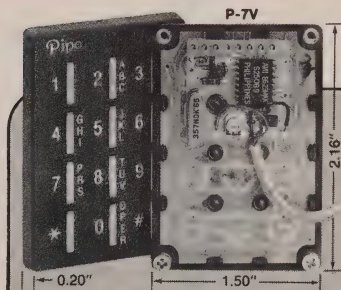
WE'LL BUY YOUR EXTRA RIG
STATIONS-ESTATES ETC.

Call 913/381-5900

FAX 913 648 3020

SEND \$2 FOR CATALOG
AND WHOLESALE LIST

Please send all reader inquiries directly.



DTMF/steel keys!
sealed gold contacts!

• COLOR: All keyboards come in BLACK. . .
OPTIONAL: Specify DARK BROWN • Contacts
are: WATER PROOF/DUST PROOF • Completely
self contained - NO RF! • Simple 3-wire connection •
Output level adj. • Wide operating range 4 to 16 VDC •
Wide temperature range -22° to +160°F • Supplied with
instructions, schematic, template & hardware.

P-7V 12 KEY VERT. \$53*

CALL OR WRITE

P-7H 12 KEY HORIZ. \$53*

FOR FREE CATALOG

P-8V 16 KEY VERT. \$57*

*Request quantity pricing

Mail
Order
To:

PipoCommunications®

Emphasis is on Quality & Reliability

P.O. Box 2020
Pollock Pines, California 95726
916-644-5444
FAX 916-644-PIPO

165

BEVERAGE ANTENNA HANDBOOK

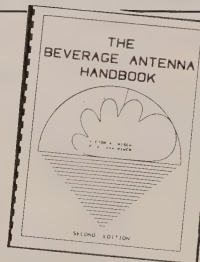
by Vic Misek, W1WCR New Edition

W1WCR has spent countless hours developing new antenna ideas and optimizing the SWA (Steerable wave antenna). Misek delves deep into the secrets of the single wire Beverage with helpful hints and tips on how to maximize performance based upon wire size, height above ground, overall length and impedance matching. Also includes information on center fed Beverages constructed out of several wire types. **SMALL LOT OWNERS** — Beverage for you too! Called the Micro-SWA, it is just 60 ft long. You get excellent directivity and null steering capabilities. Transformer design information for both termination and feedline matching is completely revised. © 1987 80 pages

VM-BAH

Softbound \$14.95

**FULLY
REVISED**



Please enclose \$3.50 shipping & handling

**HAM
RADIO BOOKSTORE**

GREENVILLE, NH 03048 603-878-1441

PC Slow Scan \$149.95

A complete slow scan television station for your IBM PC or compatible. Send and receive images in up to 10 shades of gray depending upon your graphics card and printer.

Includes:

Demodulator Software 75 Page Manual
Modulator Tutorial Cassette

Requires:

Ham transceiver PC with 640K Parallel Port
Graphics Card Tape Recorder Serial port

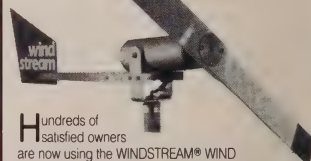
Slow Scan Formats: 8,12,17,23,34,36,48,72 sec.



Software Systems Consulting
1303 S. Ola Vista
San Clemente, CA 92672
(714) 498-5784

163

Generate Your Own Electricity



Hundreds of satisfied owners are now using the WINDSTREAM® WIND GENERATOR to provide power for RVs, weekend cottages, boats, workshops, remote locations, emergency back up power and much more. Portable—weighs only 20 lbs.—easily installed with our comprehensive installation manual—minimum maintenance—full warranty.

Thermax Corporation H

P.O. Box 3128, Burlington, VT 05401-3128

164

Where's the Beam?

There's a 20 meter antenna with real DX Punch hidden in this picture. You can't see it, and your neighbors can't either. But the DX bears it anyway. How about a low profile 80/40/30 or 40/30/20/15 m. beam? Or a pair of DX grabbing monobanders for the same? All easily fit the pocketbook—from \$29 to \$99. Unobtrusive DX Gain Antennas for 80 thru 10. Easily hidden • Install Fast • Fixed/Portable. Work DX without telling the neighbors.

Antennas West
(801) 373-8425 Airmail Infopack \$1
Box 50062, H. Provo, UT 84605

128

product REVIEW

N6RJ's Computerized Second Op v1.01

Those of you who go back a few years will remember W9IOP's manual Second Op. This handy operating aid was updated by *HR* and N6RJ in the early 80's to reflect the latest postal rates, callsign assignments, and other helpful information.

N6RJ and KL7GRF have taken the next logical step by integrating the power of the MS-DOS computer with the Second Op. Their new computerized version has just been made available.

This new program isn't a rehash of the old Second Op. It surpasses the older version and offers almost every feature you could want in a data base type program. Here's what you get:

Logging and scanning of log capabilities, oblast, QSL bureaus, bearing-sunrise-sunset, and add and edit notes on countries. Print functions include a DXCC country list with distance, bearing, DXCC "need" list, Oblast worked/confirmed, Oblast log, and many other different log printing capabilities. In summary mode you can show: DXCC worked/confirmed on all bands, one band, one band and one mode, by mode, detailed spreadsheet worked/confirmed for each band, and mode with mixed totals; WAZ by band, mode or both, and 6-band WAZ summary; and total station entries in log. In the log print mode you can print your DXCC need list (by mode or mixed), or your entire log in almost any format imaginable. The Second Op supports most printers and includes laser printer drivers.

One of the most maddening aspects of operating is keeping an up-to-date country list handy for all the different prefixes in use. This is where the Second Op really shines. Ask the computer to find a country by prefix and you have the information you need in a flash (see fig. 1). Have only an old prefix and want to cross it to the new ones? Second Op can do that too!

Oblast hunters will find that the new Second Op is a great addition to their shack. (Working Oblasts on 160 is difficult so I don't have much experience here.) After reviewing this function, I found that I understood more about Oblasts than I ever did before. You can find Oblasts by entering either callsign or Oblast number. You can also keep a running record of worked and confirmed Oblasts.

The owner's manual is one of the best I have ever seen. It clearly documents each and every feature, and gives full and complete installation instructions. Novice computer users may be interested to know that KL7GRF is available to help with any problems running the Second Op. I must admit that, as MS-DOS is still an enigma to me, I had problems getting the program to work properly myself. A quick phone call to GRF brought plenty of helpful hints and a full explanation of what I had done wrong. Within minutes I was able to correct my mistakes and get the program to run flawlessly.

This value-packed program is a welcome addition to the ham shack. All hams, from contesters and honor roll DX'ers to casual operators, will find that the new Second Op adds greatly to their computing capabilities. I'm sure that W9IOP would be proud to see what his Second Op has become and would have one in his shack.

The New Second Op is available from the **HAM RADIO Bookstore** for \$59.95 plus \$3.50 shipping and handling.

de N1ACH

FIGURE 1

N6RJ 2ND OP 17:09 UTC

Prefix.....VU	DXCC Country..INDIA	
CQ Zone.....22	Kilometers...14021	Location...BOMBAY
Continent.....AS	Long Path....167	Sunrise....00:59 UTC
Direct Bearing.347	Return Path....10	Sunset....13:11 UTC
Nautical Miles.7571	Latitude.....19.00 N	3rd Party..NO
Statute Miles..8712	Longitude....72.80 E	Reciprocal.YES
Air Mail.....0.45	N6RJ Notes...	
Air QSL Card..0.36	Notes line 1.	
IRC.....4	Notes line 2.	
ARRL Bureau...YES	Country....Worked:Y	Confirmed:Y
DISPLAYING/SEARCHING BY PREFIX		

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
FIND	NEXT	PRIOR	ORDER	EDIT	BEARING	BUREAU	LOG	HELP	MENU

This is the print screen display of what you'd see when you enter VU (by prefix). For the larger countries additional bearing and sunrise/sunset information is available. When you hit the F6, or bearing key (displayed here), you'll see what's printed on the next page.



New switch design

Alpha Delta's model Delta-4/4N switch incorporates several significant design improvements.

The new switch allows Easy Arc-Plug cartridge access through the front panel. The previous design required the removal of the back-plate.



Front panel access makes permanent switch mounting possible. The pill can be removed with a magnetized screwdriver blade, after you unscrew the hex retainer. The Delta-4 also has a redesigned roller bearing drive for a smoother "feel" during rotation.

Because many people mount the switch on a desk top, all the connectors run along one side so that the coax cables can run back behind the desk.

Models are available with UHF (SO-239) or type "N" connectors.

For more information contact Alpha Delta Communications, P.O. Box 571, Centerville, Ohio 45459.

Circle #301 on Reader Service Card.

1.2-GHz handheld transceiver

ICOM has introduced the new 1.2-GHz IC-12GAT handheld transceiver. It features: wideband coverage, one-watt power output,



Ham Radio's guide to help you find your local

California

A-TECH ELECTRONICS

1033 HOLLYWOOD WAY
BURBANK, CA 91505
(818) 845-9203

New Ham Store and Ready to Make a Deal!

JUN'S ELECTRONICS

3919 SEPULVEDA BLVD.
CULVER CITY, CA 90230
213-390-8003
800-882-1343 Trades
Habla Espanol

Colorado

ALLIED APPLIANCE & RADIO

4253 SOUTH BROADWAY
ENGLEWOOD, CO 80110
(303) 761-7305

Rocky Mts Amateur/Shortwave Specialists, Ten-Tec, Yaesu, JRC-NRD, Sony, MFJ, KLM, and other fine gear. New and used. Visa/MC. Antennas, books, discount prices too!

COLORADO COMM CENTER

525 EAST 70th AVE.
SUITE ONE WEST
DENVER, CO 80229
(303) 288-7373
(800) 227-7373
Stocking all major lines
Kenwood Yaesu, Encomm, ICOM

Connecticut

HATRY ELECTRONICS

500 LEDYARD ST. (SOUTH)
HARTFORD, CT 06114
203-527-1881

Call today. Friendly one-stop shopping at prices you can afford.

Delaware

AMATEUR & ADVANCED COMMUNICATIONS

3208 CONCORD PIKE
WILMINGTON, DE 19803
(302) 478-2757
Delaware's Friendliest Ham Store.

DELAWARE AMATEUR SUPPLY

71 MEADOW ROAD
NEW CASTLE, DE 19720
302-328-7728
800-441-7008
Icom, Ten-Tec, Microlog, Yaesu, Kenwood, Santec, KDK, and more. One mile off I-95, no sales tax.

Florida

AMATEUR ELECTRONIC SUPPLY

1898 DREW STREET
CLEARWATER, FL 33575
813-461-4267
Clearwater Branch
West Coast's only full service
Amateur Radio Store.
Hours M-F 9-5:30, Sat. 9-3

AMATEUR ELECTRONIC SUPPLY

621 COMMONWEALTH AVE.
ORLANDO, FL 32803
305-894-3238
Fla. Wats: 1 (800) 432-9424
Outside Fla: 1 (800) 327-1917
Hours M-F 9-5:30, Sat. 9-3

Georgia

DOC'S COMMUNICATIONS

702 CHICKAMAUGA AVENUE
ROSSVILLE, GA 30741
(404) 866-2302 / 861-5610
ICOM, Yaesu, Kenwood, Bird...
9AM-5:30PM
We service what we sell.

Hawaii

HONOLULU ELECTRONICS

819 KEEAUMOKU STREET
HONOLULU, HI 96814
(808) 949-5564
Kenwood, ICOM, Yaesu, Hy-Gain, Cushcraft, AEA, KLM, Tri-Ex Towers, Fluke, Belden, Astron, etc.

Idaho

ROSS DISTRIBUTING COMPANY

78 SOUTH STATE STREET
P.O. BOX 234
PRESTON, ID 83263
(208) 852-0830
M 9-2; T-F 9-6; S 9-2
Stock All Major Brands
Over 7000 Ham Related Items on Hand

Illinois

ERICKSON COMMUNICATIONS, INC.

5456 N. MILWAUKEE AVE.
CHICAGO, IL 60630
312-631-5181
Hours: 9:30-5:30 Mon, Tu, Wed & Fri;
9:30-8:00 Thurs; 9:00-3:00 Sat.

Indiana

THE HAM STATION

220 N. FULTON AVE.
EVANSVILLE, IN 47710
(800) 523-7731
(812) 422-0231
ICOM, Yaesu, Ten-Tec, Cushcraft, Hy-Gain, AEA & others.

Maryland

MARYLAND RADIO CENTER

8576 LAURELDALE DRIVE
LAUREL, MD 20707
301-725-1212
Kenwood, Ten-Tec, Kantronics. Full service dealer.
M-F 10-7 SAT 9-5

Massachusetts

TEL-COM, INC.

675 GREAT ROAD, RTE. 119
LITTLETON, MA 01460
617-486-3400
617-486-3040
The Ham Store of New England
You Can Rely On.

Missouri

MISSOURI RADIO CENTER

102 NW BUSINESS PARK LANE
KANSAS CITY, MO 64150
(800) 821-7323
Missouri: (816) 741-8118
ICOM, Kenwood, Yaesu
Same day service, low prices.

Nevada

AMATEUR ELECTRONIC SUPPLY

1072 N. RANCHO DRIVE
LAS VEGAS, NV 89106
702-647-3114
Dale Porray "Squeak," AD7K
Outside Nev: 1 (800) 634-6227
Hours M-F 9-5:30, Sat. 9-3

New Hampshire

RIVENDELL ELECTRONICS

8 LONDONDERRY ROAD
DERRY, N. H. 03038
603-434-5371
Hours M-S 10-5; THURS 10-7
Closed Sun/Holidays

Dealers: *YOU SHOULD BE HERE TOO!*
Contact Ham Radio now for complete details.



New Jersey

ABARIS SYSTEMS

276 ORIENTAL PLACE
LYNDHURST, NJ 07071
201-939-0015
Don WB2GPU
ARRL, Astatic, Astron, B&W, Belden,
Bencher, Hustler, Kenwood, Larsen, RF
Concepts, Tonna and much, much more!
Tues-Fri 10 am-7:30 pm
Thurs 10 am-9:00 pm
Sat 10 am-4:00 pm
VISA/MC

KJI ELECTRONICS

66 SKYTOP ROAD
CEDAR GROVE, NJ 07009
(201) 239-4389
Gene K2KJL
Maryann K2RVH
Distributor of: KLM, Mirage, ICOM, Lar-
sen, Lunar, Astron. Wholesale - retail.

New York

BARRY ELECTRONICS

512 BROADWAY
NEW YORK, NY 10012
212-925-7000
New York City's Largest Full Service
Ham and Commercial Radio Store.

VHF COMMUNICATIONS

915 NORTH MAIN STREET
JAMESTOWN, NY 14701
716-664-6345
Call after 7 PM and save! Supplying all
of your Amateur needs. Featuring ICOM
"The World System." Western New
York's finest Amateur dealer.

Ohio

AMATEUR ELECTRONIC SUPPLY

28940 EUCLID AVE.
WICKLIFFE, OH 44092 (Cleveland Area)
216-585-7388
Ohio Wats: 1 (800) 362-0290
Outside Ohio: 1 (800) 321-3594
Hours M-F 9-5:30, Sat. 9-3

DEBCO ELECTRONICS, INC.

3931 EDWARDS RD.
CINCINNATI, OHIO 45209
(513) 531-4499
Mon-Sat 10AM-9PM
Sun 12-6PM
We buy and sell all types of electronic
parts.

UNIVERSAL AMATEUR RADIO, INC.

1280 AIDA DRIVE
REYNOLDSBURG (COLUMBUS), OH
43068
614-866-4267
Featuring Kenwood, Yaesu, Icom,
and other fine gear. Factory author-
ized sales and service. Shortwave
specialists. Near I-270 and airport.

Pennsylvania

HAMTRONICS,

DIV. OF TREVOSE ELECTRONICS
4033 BROWNSVILLE ROAD
TREVOSE, PA 19047
215-357-1400
Same Location for over 30 Years

Texas

MADISON ELECTRONICS SUPPLY

3621 FANNIN
HOUSTON, TX 77004
713-520-7300
Christmas?? Now??

K COMM dba THE HAM STORE

5707A MOBUD
SAN ANTONIO, TX 78238
512-680-6110
800-344-3144
Stocking all major lines. San Antonio's
Ham Store. Great Prices — Great
Service. Factory authorized sales and
service.
Hours: M-F 10-6; SAT 9-3

MISSION COMMUNICATIONS

11903 ALEIF CLODINE
SUITE 500 (CORNER HARWIN &
KIRKWOOD)
HOUSTON, TEXAS 77082
(713) 879-7764
Now in Southwest Houston—full line
of equipment. All the essentials and
extras for the "ham."

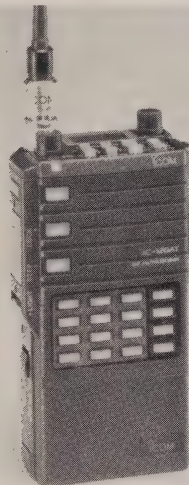
Wisconsin

AMATEUR ELECTRONIC SUPPLY

4828 W. FOND DU LAC AVE.
MILWAUKEE, WI 53216
414-442-4200
Wisc. Wats: 1 (800) 242-5195
Outside Wisc: 1 (800) 558-0411
M-F 9-5:30 Sat 9-3

twenty memory channels, programmable and memory scan, and a built-in 1750-Hz repeater access tone.

The IC-12GAT also includes: built-in battery saver, built-in DTMF keyboard, programmable call channel, all subaudible tones, multi-function LCD readout and DTMF pad. The new "G Series" handhelds are compatible with all ICOM IC-2AT/IC-02AT series battery packs, headsets and speaker mics.



An optional UT-40 beeper silently monitors a busy channel for your calls. When the pre-programmed subaudible tone and frequency is received, the unit beeps and the LCD flashes.

The ICOM IC-12GAT is available for a suggested list price of \$529.00. For further information, please contact ICOM America, 2380-116th Avenue, NE., Bellevue, Washington 98004.

Circle #302 on Reader Service Card.

Monitor your local weather conditions

Azimuth's new WeatherStar Model TWR-3 by Digitar gives you the ability to monitor important local weather conditions affecting your antenna system and shack. The TWR-3's stand-alone computer with LCD readout gives wind direction (2 or 10 degree increments) or speed (MPH or KMH), records high wind gusts, external temperature (F or C), and wind chill factor. It also records low and high temp, time, and daily and yearly rainfall with an optional self dumping rain collector (\$49.95). The unit's Scan Mode let's you see the data in any sequence. It operates on 3 AAA batteries. Optional AC adaptor, NiCd Battery Pack and desk stand are available.



ELMER'S NOTEBOOK

Tom McMullen, W1SL

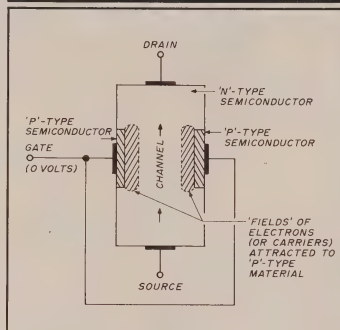
FETs—the other transistors

When I discussed bipolar transistors in last month's column, I made reference to Field-Effect Transistors (FETs). Let's look at a few ways that these transistors differ from their bipolar cousins in both construction and operation. Field-effect and bipolar transistors share a common chemistry — both use "N" or "P"-type semiconductor material. The type designations tell you whether there is a surplus of electrons (N type) or a scarcity of electrons (P type) in the basic make-up of the material. The transistors differ in their manner of operation and how the N or P material is made to control the flow of electrons.

Putting the pieces together

Let's use a FET that is constructed of N-type material to explore what happens inside. The body of the transistor is made of material having a surplus of electrons. This body, called a "channel," must have connections at each end for application of the external power source. One connection is made to the negative (−) terminal of a supply or battery and one to the positive (+) terminal. In FET terminology, one of these connections is a "source," and the other is a "drain." It makes sense when you consider that the source is where the electrons come from and the drain is where they go (see fig. 1). In order to control the current flow between the drain and source, you must add another element — a "gate." The gate is another terminal connected to the body of the

FIGURE 1



A simple FET has basically two parts: a channel for electron flow, and a gate to control that flow. The channel here is N-type material, and the gate is P-type. The shaded region near the gate area indicates "depletion" zones that affect the current flow in the channel. With zero volts on the gate, the zones are small, allowing current to flow.

FET, but not in exactly the same way as the source and drain.

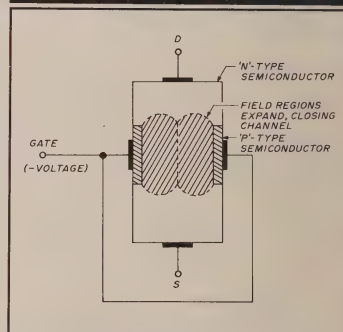
The gate terminal is attached to P-type material that is deposited on the N-type channel. This P-type material has a scarcity of electrons, and the lack of electrons creates a "field" that extends into the channel material. Electrons (carriers) in the N-type channel are attracted to the gate material, but are stopped from getting through by a very thin barrier between the two. When the field caused by this attraction is small, and confined to an area near the gate, current can flow easily from source to drain. (Actually, that's a gross simplification of what happens. Theoretical purists talk about things like minority and majority carriers,

valence bonds, enhancement and depletion modes. I prefer to keep it simple.) In the FET's normal resting state, full current flow takes place with the gate at zero volts. The shaded area in fig. 1 shows the "field" at minimum, with the channel open for current flow.

Putting on the pinch

Things start to happen when a voltage is applied to the gate. If the voltage is positive, the field shrinks, opening the channel more than normal. If the voltage is negative, the field becomes larger. The enlarged field decreases the current flow between source and drain. If the field becomes large enough it blocks the flow completely, as shown in fig. 2. This blocking of a path between the source and

FIGURE 2



When a voltage of the correct polarity is applied to the gate, the depletion zone expands, decreasing current flow. In this case, a negative (−) voltage has increased the depletion zone to the point where all current is stopped. This is called the "pinch-off" effect.



The unit is portable and comes with wind vane, anemometer, weather computer unit, and 40 feet of control cable (extendable to 200 feet). The complete TWR-32 unit is \$159.95 plus \$4.95 shipping and handling. Foreign orders add \$17.00 shipping. Get a special FREE bonus Azimuth Dual-Zone 24 hour Station/Travel Clock with 15 world-wide cities (a \$29.95 value).

For details contact Azimuth Weatherstar, Department HR, 11845 W. Olympic Boulevard, Suite 1100, Los Angeles, California 90046. Credit card orders: call toll free 1-800-882-7388.

Circle #303 on Reader Service Card.

New Bird Model 43P wattmeter and 4300-400 retrofit kit

The Bird Electronic Corporation Model 43 THRULINE® wattmeter is now available in a true peak power reading version. The 43P lets you measure true peak power of single sideband, AM modulated RF, and certain limited rectangular pulse signals to an 8 percent F.S. accuracy, without affecting CW measurement capabilities. It uses standard Bird plug-in elements. Depending on the element selected, the overall frequency range is 450 kHz to 2.3 GHz, and RF power is 100 mW to 10,000 watts.

The peak power measuring circuitry is powered by two 9-volt NEDA-type 1604 batteries, with an anticipated life of 48 hours in the peak mode.

Owners of the standard Model 43 can modify their units with a retrofit kit, Model 4300-400, to obtain the same peak power measuring capability as the 43P. The kit includes a pc board which mounts inside the Model 43 housing.

For more information contact your Bird distributor, or the Bird Electronic Corporation, 30303 Aurora Road, Solon, Ohio 44139-2794.

Circle #304 on Reader Service Card.

Alpha Delta Model DELTA-4 Lightning Surge Protected 4-Position RF Coax Switch

Easy access to Arc-Plug cartridge through front panel allows permanent switch mounting to any surface

NEW



also available with N-type connectors

- Exclusive center "off" (ground) position internally disconnects and grounds all antenna circuits for maximum protection when operator is away from the station — an Alpha Delta first!
- Incorporates the famous replaceable Arc-Plug® cartridge for continuous protection of the active antenna circuit. Unused antenna circuits are automatically grounded — an Alpha Delta first!
- The Model DELTA-4 Switch features a custom designed cast housing with constant impedance micro-strip cavity construction for outstanding performance through UHF. No lossy wafer switches are used.

- Positive detent roller bearing switch drive tells you which position you're in ... without guessing ... without looking.
- DELTA-4 handles full legal power.
- Designed and produced in the U.S.A. by Alpha Delta.

Model DELTA-4 (UHF connectors, 500 MHz) \$74.95
Model DELTA-4/N (N-type connectors, 1.3 GHz) \$89.95

Available from your local Alpha Delta Dealer or direct. Add \$4.00 shipping and handling (U.S.A. only) Exports quoted.

See Data Sheet for surge limitations.

ALPHA DELTA COMMUNICATIONS, INC.

P.O. Box 571, Centerville, OH 45459 • (513) 435-4772 Orders

current solutions to current problems



ELIMINATES RF INTERFERENCE IN: TV sets, Radios, Hi-Fi, PA systems, Telephones, VCRs, Test equipment, Burglar and Fire alarms, Modems, Monitors, Computers, Radio and TV stations, etc.

EASY TO USE: fits over and snaps onto small, large and ribbon cables. No need to rewire connectors. Unique, split ferrite core design fits up to RG8U coax cables.

WORKS IN "COMMON MODE", filters current induced in the braid of shielded cables and ground wires!

Special ferrite material effective 0.5 - 200 MHz.

DOES NOT VOID EQUIPMENT WARRANTY

Available from your dealer or order direct from:

computeradio

Box 282, Pine Brook, NJ 07058
Tel: (201) 227-0712

Send personal check with order, we ship same day First Class. 30-day money back warranty. Quantity discounts.

Package of 4 chokes with inst. instructions
\$12.99
+ \$2.00 shipping

BATTERIES

Nickel-Cadmium, Alkaline, Lithium, Etc.
INDUSTRIAL QUALITY

**YOU NEED BATTERIES?
WE'VE GOT BATTERIES!**

CALL US FOR FREE CATALOG

✓ 169

E.H.YOST & CO.

EVERETT H. YOST KB9X1

7344 TETIVA RD.

SAUK CITY, WI 53583

ASK FOR FREE CATALOG

(608) 643-3194



WACOM DUPLEXERS

Our Exclusive Bandpass-Reject Duplexers
With Our Patented

B_p B_r CIRCUIT® FILTERS



provide superior performance ... especially at close frequency separation.

Models available for all commercial and ham bands within the frequency range of 30 to 960 MHz.

CALL
817/848-4435



WACOM PRODUCTS, INC.

P.O. BOX 21145

WACO, TEXAS 76702 • 817/848-4435

✓ 166

February 1989 **h** 105

drain is called the "pinch-off" effect because it pinches off, or closes, the channel so that current can't flow.

Think of the channel as a rubber hose connected between a water faucet (the source) and your kitchen sink (the drain). If you squeeze the hose between your thumb and finger, you "pinch off" the flow of water. When you relax your thumb and finger, some water will flow. You control the flow by changing the pressure exerted by your fingers.

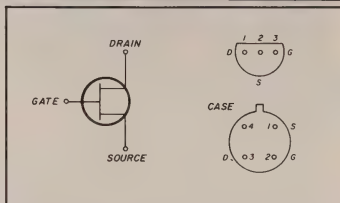
The FET works in much the same way. The depth of the field near the gate material can be altered to change the current flow by adjusting the voltage (voltage is the electrical equivalent of pressure). When more voltage is applied to the gate terminal, the pinch-off region gets larger, and less current flows through the channel.

These relatively simple FETs are sometimes called JFETs, for Junction Field-Effect Transistors. The gate and channel material and the junctions resemble a diode, and the "boundary" separating the N and P material is very thin. Once the gate voltage is high enough to overcome that boundary, the device acts just like a diode, and the field-effect performance is lost.

This limitation is overcome in some FETs by the introduction of a thin insulator between the gate and the channel material. The insulator prevents diode action and, at the same time, increases the input resistance of the gate tremendously. These devices are sometimes called IGFETs (Insulated Gate Field-Effect Transistors) or MOSFETs (Metal-Oxide Semiconductor Field-Effect Transistors). Still other varieties have more than one gate, and some contain exotic materials (like sapphire). These transistors are tailored to a specific industry need or purpose; we don't need to get into their physics and chemistry at this point.

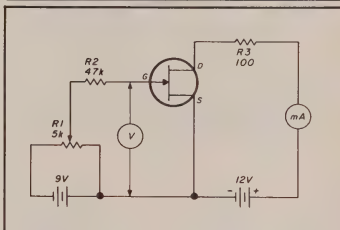
The schematic symbol for a FET is shown in **fig. 3**. The direction of the arrowhead on the gate connection indicates whether the device is an "N-channel" type or "P-channel" type. Some manufacturers place the arrowhead on the source lead instead of the

FIGURE 3



The schematic symbol for a FET, and two common base diagrams. The direction of the arrow on the gate connection tells whether the FET is an "enhancement" or "depletion" type, but is not as useful to us for identification as was the emitter symbol in bipolar transistors. Please note that there are many different base diagrams, so be sure to find the correct one before hooking up any device.

FIGURE 4



Schematic diagram of the hookup used in the experiment described in the text.

gate. There are no easy "clues" for using the direction of the arrow to determine the type of device, but I have noticed that the majority of manufacturers have the arrow pointing in for N-channel FETs.

Checking the theory

Now that I've discussed how FETs are supposed to work, it's time to get out the meters, batteries, resistors, etc., and see what really happens. First, look at a specifications sheet to see what you should expect. I have a plastic parts drawer full of miscellaneous FETs; one of them has a label I can still read — 2N5486. This is an RF-amplifier device, so a change in gate voltage should produce a somewhat linear response in the drain current (as opposed to a switching-type device where the change would be abrupt). The specifications sheet tells me that

maximum voltage between drain and source is 25Vdc, the maximum drain current (I_D) is 30 mA, and that the device maximum dissipation is 310 mW, so I'll keep those limits in mind. One column on the sheet shows that the gate reverse current at 15 Vdc is 1 nA! That's 1×10^{-9} A (0.000,000,010 A). I don't have a meter that will measure such a small current, so I'll take their word for it! **Figure 4** shows the setup used for measurement in this experiment.

Because a FET is supposed to be a voltage-operated device, the 47-k resistor (R_2) connected to the gate should have no effect other than limiting current flow in case something shorts in the night. The 100-ohm drain resistor, R_3 , provides drain short-circuit protection. Gate voltage is adjusted by means of a 5-k potentiometer, R_1 .

If things work the way the numbers predict, the FET should show current flow as soon as I complete the circuit between source and drain, with no voltage on the gate. Sure enough, that's what happens. The meter shows 18 mA, which is within the range of 8–20 mA listed for this FET. The voltage from drain to source is 12, so the device is dissipating 0.216 watts, or 216 mW — comfortably below the 310-mW limit given in the spec sheets.

Theory says that if I place a negative (–) voltage on the gate, the channel should close, decreasing current flow. I decided to give it a try. At –0.5 volt on the gate, drain current started to drop. The reading was 14 mA. Increasing the gate voltage caused drain current to decrease even more, until at 4.5 volts the current was too small to measure with my simple milliammeter. The graph in **fig. 5** shows the results of measuring gate voltage versus drain current at several points along the way. Incidentally, a 0–50 μ A meter placed in series with R_2 showed only a tiny flicker of movement, indicating that little or no current was flowing in the gate circuit.

What about applying a positive voltage to the gate? After I reversed the 9-volt battery, a gate voltage of + 0.1

THE MOST AFFORDABLE REPEATER

ALSO HAS THE MOST IMPRESSIVE
PERFORMANCE FEATURES
(AND GIVES THEM TO YOU AS STANDARD EQUIPMENT!)

KIT, ONLY \$675

WIRED \$975

VHF OR UHF



FEATURES:

- **SENSITIVITY SECOND TO NONE!** GaAsFET front end on vhf models gives 12dB SINAD of 0.12uV (vhf), 0.15uV (220). UHF model 0.25uV std, 0.1uV with optional helical resonator preamp.
- **SELECTIVITY THAT CAN'T BE BEAT!** Both 8-pole xtal filter & ceramic filter for > 100dB at only ±12kHz. Helical resonator front end to combat desense & intermod.
- **CLEAN, STABLE TRANSMITTER,** up to 18W output standard; 50W with accessory power amplifier.
- **FCC TYPE ACCEPTED** for commercial high band and uhf.
- **Courtesy beep,** field-programmable CWID, flutter-proof squelch, automatic frequency control to compensate for off-frequency transmitters (all standard features).
- **Full range of options** available, such as autopatch, phone line or radio remote control, sub-audible tones, duplexers.

HIGH PERFORMANCE TRANSMITTERS & RECEIVERS FOR REPEATERS AUDIO & DIGITAL LINKS, TELEMTRY, ETC.

•FM EXCITERS:

Kits \$99, w/t \$179. 2W continuous duty. TCXO & xtal oven options available.

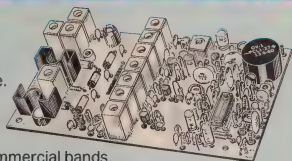
• **TA51 for 10M, 6M, 2M, 150-174, 220 MHz.**

• **TA451 for uhf.**

FCC type accepted for commercial bands.

• Call for latest information on 900 MHz transmitters.

• **VHF & UHF AMPLIFIERS.** For FM, SSB, ATV. Output from 10 to 50 Watts. Several models, kits starting at \$79.



•R144/R220 FM RECEIVERS for 2M,

150-174, or 220 MHz. GaAs FET front end, 0.12uV sensitivity!

Both crystal & ceramic filters plus helical resonator front end for exceptional selectivity: > 100dB at ±12kHz (best available anywhere)! Flutter-proof squelch. AFC tracks drifting transmitters.

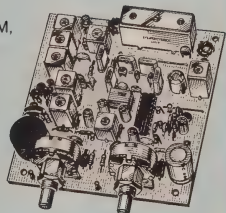
Kit \$149, w/t \$229.

• **R451 UHF FM RCVR.** Similar to above. Tuned line front end, 0.25uV sens. (0.1uV with optional hel. res. preamp). Kit \$149, w/t \$229.

• **R901 FM RCVR for 900 MHZ.** Triple-conversion, GaAs FET front end, 0.2uV sens. Kit \$169, w/t \$259.

• **R76 ECONOMY VHF FM RCVR for 10M, 6M, 2M, 220.** Without hel res or afc. Kits only \$129.

• **Weather satellite & AM Aircraft receivers also avail.**



FCC TYPE-ACCEPTED TRANSMITTERS & RECEIVERS AVAILABLE
FOR HIGH-BAND AND UHF. CALL FOR DETAILS.

- Send \$1 for 36 page catalog by return mail. (Send \$2.00 or 4 IRC's for overseas mailing)
- Order by phone or mail • Min \$3 S & H per order
- Use Visa, Mastercard, Check, or UPS COD.

GaAs FET PREAMPS
at a fraction of the cost of
comparable units!

LNG -(*)

**GaAs FET
PREAMP**

ONLY \$59!

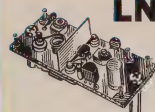
Wired/tested



FEATURES:

- **Very Low Noise:** 0.7dB VHF, 0.8dB UHF
- **High Gain:** 13-20dB, depending on frequency
- **Wide Dynamic Range:** to resist overload
- **Stable:** new-type dual-gate GaAs FET

* Specify tuning range desired: 26-30, 46-56, 137-150, 150-172, 210-230, 400-470, or 800-960 MHz.



LNW -(*)

**MINIATURE
GaAs FET
PREAMP**

ONLY \$24/kit,

\$39 Wired/tested

GaAs FET Preamp

similar to LNG, except designed for **low cost & small size.** Only 5/8" W x 1-5/8" L x 3/4" H. Easily mounts in many radios.

* Specify tuning range desired: 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, or 400-500 MHz.

LNS -(*)

**IN-LINE
PREAMP**

ONLY \$79/kit,

\$99 Wired/tested



GaAs FET Preamp with features similar to LNG series, except **automatically switches out of line during transmit.** Use with base or mobile transceivers up to 25W.

* Specify tuning range desired: 120-175, 200-240, or 400-500 MHz.

HELICAL RESONATOR PREAMPS

Low-noise preamps with helical resonators **reduce intermod & cross-band interference** in critical applications.

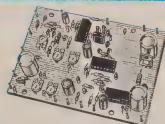
MODEL HRA-(*), \$49 vhf, \$84 uhf.

* Specify tuning range desired: 143-150, 150-158, 158-162, 162-174, 213-233, 420-450, 450-465, or 465-475 MHz.

**NEW HIGH-SPEED
DIGITAL RF
LINKS**

You've waited a long time for a simple, reliable, low-cost **9600 baud PACKET NETWORKING system.** Now you've got it! Our new **MO-96 MODEM** and direct **FSK Transmitters and Receivers** for 220 or 440 MHz interface directly with most TNC's. Fast diode switched PA's output 15 or 50W. Call for complete info on the right system for your application.

ACCESSORIES



• **COR-3 Kit.** Control ckts and audio mixers needed to make a repeater. Tail & time-out timers, local spkr ampl, courtesy beep \$49

• **CWID Kit.** Field programmable, timers, the works \$59

• **TD-2 DTMF DECODER/CONTROLLER Kit.** Full 16 digits, switches 5 functions, toll call restrictor, programmable, much more. Great for selective calling tool \$79

• **AP-3 AUTOPATCH Kit.** Use with above for repeater autopatch. Reverse patch and phone line remote control std. \$79

• **AP-2 SIMPLEX AUTOPATCH TIMING BOARD Kit.** Use with above for simplex autopatch \$39

• **MO-202 FSK DATA MODULATOR Kit.** Run up to 1200 baud digital signals through any fm transmitter with full handshakes. Radio link computers, telemetry gear, etc. \$39

• **DE-202 FSK DATA DEMODULATOR Kit** for rcvr end of link \$39

RECEIVING CONVERTERS



VHF MODELS	Antenna Input Range	Receiver Output
Kit with Case	28-32	144-148
Kit less Case	50-52	28-30
Wired w/case	136-138	144-148
	144-146	28-30
	146-147	28-30
	146-148	28-30
	220-222	50-54
	220-224	50-54
	222-224	28-30

UHF MODELS	Antenna Input Range	Receiver Output
Kit with Case	432-434	28-30
Kit less Case	432-436	144-148
Wired w/case	432-436	50-54
	439-35	61-35
	902-928	422-448
	902-922	430-450

See catalog for full line of 2w transmitting converters for vhf & uhf. Kits only \$79. Linear Amplifiers avail. up to 50 w.

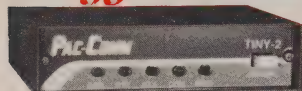
Our 25th Anniversary

hamtronics, inc.

65-H MOUL ROAD • HILTON NY 14468-9535

Phone: 716-392-9430 Hamtronics is a registered trademark

Affordable Packet



TINY-2 is our new low-cost high-performance standard for packet controllers. Thousands already in use, worldwide. A perfect beginner's unit.

Complete, wired and tested, only **\$119.95**

BENEFITS and features of both units:

- ☐ **Optional personal message system (mini-BBS) add \$10.00.**
- ☐ Tiny enough for briefcase/portable, yet large enough for easy experimentation or repair.
- ☐ 1-year limited warranty, excellent customer support.
- ☐ RS-232 and TTL compatible—all connectors supplied.
- ☐ Latest AX.25 software, TCP/IP (KISS) module included.



MICROPOWER-2 is our remarkably compact, 18-ounce unit using upgraded TAPR TNC-2 technology that requires less than 40 milliamps! For very portable operation, solar or battery, you need not pay more for a TNC that's about the size of your HT! Was \$179.95, **\$159.95** now at a low

- ☐ Fully compatible with ROSE & NET/ROM EPRoms.
- ☐ 32K RAM, 32K ROM, 4.9 MHz CPU.
- ☐ Xtal controlled modem, compatible with use on 10m HF/VHF/UHF.

TO ORDER, toll-free with major charge card, call: **1-800-223-3511**

Technical support line: 813-874-2980

Pac-Comm

3652 West Cypress St., Tampa FL 33607

Please send: ☐ Tiny 2 ☐ MicroPower-2 ☐ TNC-220 info ☐ FREE Packet Catalog.

Name _____	Call _____
Address _____	City _____
State _____ Zip _____	Card Number _____ Exp. Date _____

Money Back Guarantee. Add \$3. shipping/banding per order, FL addresses add 6%. Major Credit Card: give number, expiration and signature. FAX: 813-872-8696

✓ 170

PC HF FACSIMILE \$79.95

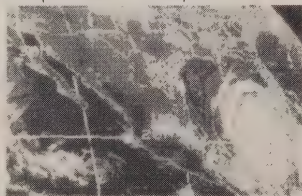
A complete facsimile reception system for your IBM PC or compatible. Receive grayscale images in up to 16 shades or pseudo color depending upon your graphics card and printer.

Includes:

Demodulator Software 50 Page Manual Tutorial Cassette

Requires:

HF receiver PC with 320K Graphics card Serial port



Software Systems Consulting
1303 S. Ola Vista
San Clemente, CA 92672
(714) 498-5784

✓ 171

LOGWRITE™

Bring your station into the computer age with LOGWRITE, the menu driven, user friendly logging program written by Ed Troy (N03V). LOGWRITE is the perfect accessory for the complete ham station. It simplifies your operation and gives you the competitive edge in contesting and DX'ing. LOGWRITE works with all IBM PCs and compatibles.

LOGWRITE's unique split screen feature allows for simultaneous logging and text processing. Logging features include:

- Instant call sign or prefix search
- Print, Edit, or View records
- Plenty of room for notes & addresses
- Automatic time/date stamping

Text processor features automatic word wrap, backspace correct, and scrolling. Throw away your pen and paper!

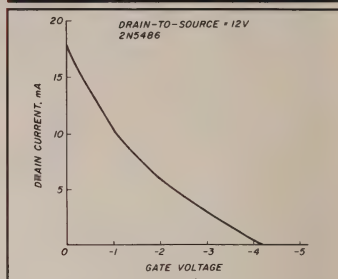
To order your copy of LOGWRITE, complete with instruction manual, send \$24.95 (Pa. residents add \$1.50 sales tax) to:

Aerospace Consulting
P.O. Box 536, Buckingham, PA 18912

Or call 1-(800) 345-4156 ext. 54 to order with Visa/MasterCard. (Please specify 3.5 or 5.25 inch floppy.)

✓ 172

FIGURE 5



The measurements obtained in the setup of fig. 4 are shown in this graph.

produced current flow of 19 mA; going to +2 volts increased drain current to 21 mA. Increasing the gate voltage to the full +9 volts produced no further increase in drain current. This indicates that the channel is wide open at approximately +2 volts on the gate, and passing all the electrons it can when the supply is 12 volts. Higher supply voltages will, of course, allow higher current to flow. If you replace the 100-ohm current-limiting resistor with a suitable load resistance (or transformer, RF choke, etc.), you can develop a respectable output voltage across the resistor in response to gate voltage changes. Thus, a small voltage change at the input can create a large voltage swing at the output, providing useful amplification.

There are other FETs that have the opposite characteristics. With these FETs, the channel is "pinched off" with zero voltage on the gate, and application of the proper polarity voltage opens the channel to current flow. You can best determine which device does what by looking at its specifications, but you can also hook up a few simple instruments and components to see for yourself.

Keep in mind that the components and meters that I've used are not precision devices, and the results may not agree exactly with those published by the manufacturers. They are, however, accurate enough for exploring the theory of operation in an inexpensive way.

The numbers I've come up with in both this experiment and that of last month's column on bipolar transistors measure only a small sample of the many transistors available. Some devices work at voltages and currents much smaller than I used; others, like power amplifiers, work with higher voltages and with currents of many amperes. The devices I've worked with here are linear — they provide a smooth change in output in response to a change in input. Others behave like switches — a change in input produces an abrupt change in output, which remains relatively constant until the input voltage is removed.

Some of the bargain packs or grab bags provide many interesting experiments at low cost, and you'll be hard pressed not to learn something from them! Why not join in the fun?

Article L

HAM RADIO

GALLATIN RADIO SUPPLY

Expert repair of Ehrhorn ALPHA 76A, 374A, 78 and 77D series amplifiers.

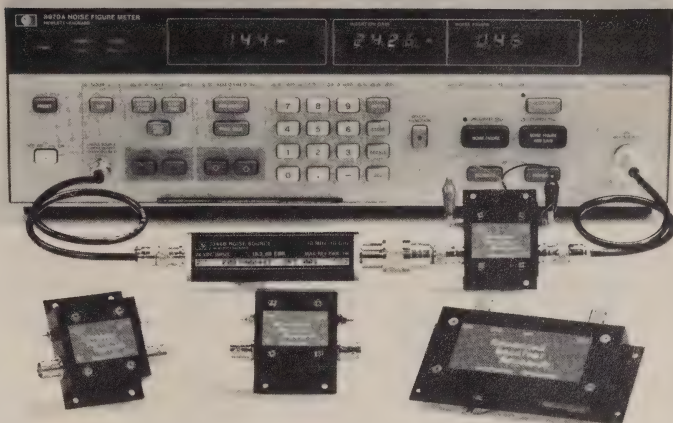
Also specializing in state-of-the-art repair and modification of the Collins KWM/HF-380 series radios. Latest up-dates available. Factory Authorized. You won't believe the improvement in your radio when it gets back!

Call for more information
or to schedule your work.

Gallatin Radio Supply
Attn: Kirby Van Horn
P.O. Box 60064
Houston, Texas 77205
(713) 320-2324

Authorized MADISON Electronics repair facility.

High Performance vhf/uhf preamps



Receive Only	Freq. Range (MHz)	N.F. (dB)	Gain (dB)	1 dB Comp. (dBm)	Device Type	Price
P28VD	28-30	<1.1	15	0	DGFET	\$29.95
P50VD	50-54	<1.3	15	0	DGFET	\$29.95
P50VDG	50-54	<0.5	24	+12	GaAsFET	\$79.95
P144VD	144-148	<1.5	15	0	DGFET	\$29.95
P144VDA	144-148	<1.0	15	0	DGFET	\$37.95
P144VDG	144-148	<0.5	24	+12	GaAsFET	\$79.95
P220VD	220-225	<1.8	15	0	DGFET	\$29.95
P220VDA	220-225	<1.2	15	0	DGFET	\$37.95
P220VDG	220-225	<0.5	20	+12	GaAsFET	\$79.95
P432VD	420-450	<1.8	15	-20	Bipolar	\$32.95
P432VDA	420-450	<1.1	17	-20	Bipolar	\$49.95
P432VDG	420-450	<0.5	16	+12	GaAsFET	\$79.95

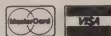
Inline (rf switched)

SP28VD	28-30	<1.2	15	0	DGFET	\$59.95
SP50VD	50-54	<1.4	15	0	DGFET	\$59.95
SP50VDG	50-54	<0.55	24	+12	GaAsFET	\$109.95
SP144VD	144-148	<1.6	15	0	DGFET	\$59.95
SP144VDA	144-148	<1.1	15	0	DGFET	\$67.95
SP144VDG	144-148	<0.55	24	+12	GaAsFET	\$109.95
SP220VD	220-225	<1.9	15	0	DGFET	\$59.95
SP220VDA	220-225	<1.3	15	0	DGFET	\$67.95
SP220VDG	220-225	<0.55	20	+12	GaAsFET	\$109.95
SP432VD	420-450	<1.9	15	-20	Bipolar	\$62.95
SP432VDA	420-450	<1.2	17	-20	Bipolar	\$79.95
SP432VDG	420-450	<0.55	16	+12	GaAsFET	\$109.95

Every preamplifier is precision aligned on ARR's Hewlett Packard HP8970A/HP346A state-of-the-art noise figure meter. RX only preamplifiers are for receive applications only. Inline preamplifiers are rf switched (for use with transceivers) and handle 25 watts transmitter power. Mount inline preamplifiers between transceiver and power amplifier for high power applications. Other amateur, commercial and special preamplifiers available in the 1-1000 MHz range. Please include \$2 shipping in U.S. and Canada. Connecticut residents add 7-1/2% sales tax. C.O.D. orders add \$2. Air mail to foreign countries add 10%. Order your ARR Rx only or Inline preamplifier today and start hearing like never before!

Advanced Receiver Research

Box 1242 • Burlington, CT 06013 • 203 582-9409



ATV CONVERTERS • HF LINEAR AMPLIFIERS

DISCOVER THE WORLD OF
FAST SCAN TELEVISION



AMATEUR TELEVISION CONVERTERS
ATV2 420-450 \$44.95 Kit
ATV3 420-450 (GaAs-FET) \$49.95 Kit
ATV4 902-928 (GaAs-FET) \$59.95 Kit

AUDIO SQUELCH CONTROL for ATV
SIL \$39.95 Kit

2 METER VHF AMPLIFIERS
35 Watt Model 33A \$79.95 Kit
75 Watt Model 875A \$119.95 Kit
Available in kit or wired and tested

HF AMPLIFIERS per MOTOROLA BULLETINS

Complete Parts List for HF Amplifiers Described in the MOTOROLA Bulletins
AN758 300W \$160.70 EB63 140W \$88.65
AN763 140W \$93.25 EB27A 300W \$139.20
AN775 20W \$93.79 EB104 600W \$448.15

NEW!! 100 WATT 10-150 MHz Amplifier

POWER SUPPLIES and COMBINERS
(2-30MHz)
600 Watt 2-Port \$59.95
1200 Watt 4-Port \$69.95

100W 420-450 MHz PUSH-PULL LINEAR
AMPLIFIER - 558-FM-ATV

KEB67-PK (Kit) \$129.95
KEB67-PCB (PC Board) \$18.00
KEB67-I (Manual) \$5.00

For detailed information and prices, call or write for our free catalog

FERROXUBE DEVICES

VK200-20/48 RF Choke \$ 1.20
50-500-45-38 Ferrite Bead \$ 20

HEAT SINK MATERIAL

Model 99 Heat Sink (5x12x1/8) \$ 22.00
CHS-6 Copper Spreader (4x4x1/4) \$ 18.00
Add \$2.00 additional shipping

We also stock Hard-to-Find parts

CHIP CAPACITORS
METALLAD MICA CAPACITORS
RF POWER TRANSISTORS
MR141C \$209.20
MR151C \$186.80
MINI-CIRCUIT MIXERS
SBL-1 \$ 6.50
SBL-1X \$ 7.95
ARCO TRIMMER CAPACITORS

Add \$ 2.00 for shipping and handling.



CCI Communication
Concepts Inc.

508 Millstone Drive, Xenia, OH 45385 • (513) 220-9677



175

1989 CALLBOOKS



THE QSL BOOK!

Continuing a 68 year tradition, we bring you three new Callbooks for 1989, bigger and better than ever!

The North American Callbook lists the calls, names, and address information for 495,000 licensed radio amateurs in all countries of North America, from Canada to Panama including Greenland, Bermuda, and the Caribbean islands plus Hawaii and the U.S. possessions.

The International Callbook lists 500,000 licensed radio amateurs in countries outside North America. Its coverage includes South America, Europe, Africa, Asia, and the Pacific area (exclusive of Hawaii and the U.S. possessions).

The 1989 Callbook Supplement is a new idea in Callbook updates, listing the activity in both the North American and International Callbooks. Published June 1, 1989, this combined Supplement will include thousands of new licenses, address changes, and call sign changes for the preceding 6 months.

Every active amateur needs the Callbook! The 1989 Callbooks will be published December 1, 1988. Order early to avoid disappointment (last year's Callbooks sold out). See your dealer now or order directly from the publisher.

- ☐ North American Callbook
incl. shipping within USA \$29.00
incl. shipping to foreign countries 35.00
- ☐ International Callbook
incl. shipping within USA \$32.00
incl. shipping to foreign countries 38.00
- ☐ Callbook Supplement, published June 1st
incl. shipping within USA \$13.00
incl. shipping to foreign countries 14.00

SPECIAL OFFER

- ☐ Both N.A. & International Callbooks
incl. shipping within USA \$58.00
incl. shipping to foreign countries 68.00

Illinois residents please add 6 1/2% tax.
All payments must be in U.S. funds.

RADIO AMATEUR
callbook INC.
Dept. F
925 Sherwood Dr., Box 247
Lake Bluff, IL 60044, USA



Tel: (312) 234-6600



ADVERTISER'S INDEX AND READER SERVICE NUMBERS

Listed below are the page and reader service number for each advertiser in this issue. For more information on their products, select the appropriate reader service number make a check mark in the space provided. Mail this form to ham radio Reader Service, I.C.A., P.O. Box 2558, Woburn, MA 01801.

Name _____ Call _____

Address _____

City _____ State _____ Zip _____

* Please contact this advertiser directly.

Please use before March 31, 1989.

READER SERVICE #	PAGE #	READER SERVICE #	PAGE #
143 - Ace Communications, IN.....	84	116 - Kantronics.....	47
173 - Advanced Receiver Research.....	109	119 - KComm, The Ham Store.....	50
109 - AEA.....	16	* Kenwood USA Corporation.....	2, 5, 7, CIV
172 - Aerospace.....	108	157 - Kepro Circuit Systems Inc.....	97
107 - All Electronics Corp.....	20	125 - Madison Electronics Supply.....	63
* Allied Appliance & Radio.....	89	* Maggiore Electronic Laboratory.....	89
167 - Alpha Delta Communications Inc.....	105	162 - Glen Martin Engineering, Inc.....	99
144 - AMC Sales, Inc.....	84	126 - The Meadowlake Corp.....	64
129 - Ameritron.....	65	139 - John J. Meshna Jr, Inc.....	78
146 - AMSAT.....	88	112 - MFJ Enterprises.....	8
128 - Antennas West.....	64, 97, 100	118 - Micro Control Specialties.....	50
141 - Antique Radio Classified.....	80	177 - Missouri Radio Center.....	111
138 - ARRL.....	72	130 - Monitoring Times.....	68
* Associated Radio.....	100	155 - Motron Electronics.....	97
102 - Astron Corp.....	28	147 - NCG.....	88
133 - ATFAB Computers and Electronics.....	71	* Nema Electronics.....	50
134 - Azimuth.....	71	* NRI School of Electronics.....	38
* Barker & Williamson.....	68	151 - Nuts & Volts.....	90
* Barry Electronics.....	85	120 - Wm. M. Nye Co. Inc.....	53
137 - Bilal Company.....	77	178 - OPTOElectronics.....	112
136 - Buckmaster Publishing.....	77	* Orlando Hamcation.....	86
* Buckmaster Publishing.....	86	104 - P.C. Electronics.....	26
149 - Buckmaster Publishing.....	88	170 - Pac-Comm Packet Radio Systems, Inc.....	108
159 - Buckmaster Publishing.....	97	165 - Pipo Communications.....	100
115 - C&S Sales.....	44	176 - Radio Amateur Callbook.....	110
* Caddell Coil Corp.....	77	108 - Radio Shack.....	19
175 - Communication Concepts, Inc.....	109	142 - Ramsey Electronics, Inc.....	81
121 - Communications Specialists.....	55	*56 - The RF Connection.....	97
168 - Computeradio.....	105	117 - RF Enterprises.....	49
113 - Connect Systems Inc.....	1	163 - Software Systems.....	100
160 - Crystek Crystals.....	99	171 - Software Systems.....	108
150 - Cygnus-Quasar Books.....	89	127 - Stridsburg Engineering Co.....	64
105 - Datacom, International.....	26	131 - STV/OnSat.....	70
* Dayton Hamvention.....	58	140 - Synthetic Textiles, Inc.....	80
153 - Doug Hall Electronics.....	93	164 - Thermax Corporation.....	100
152 - Down East Microwave.....	93	* U.S. Information Agency.....	36
132 - DRSI.....	71	* Universal Radio.....	90
* Engineering Consulting.....	86	154 - Vanguard Labs.....	93
124 - Epsilon Company.....	62	111 - Varian EIMAC.....	13
174 - Gallatin Radio Supply.....	109	158 - VHF Communications.....	97
145 - Gary Gauglar.....	86	148 - W9INN Antennas.....	88
106 - Gordon West Radio School.....	22	166 - Wacom Products Inc.....	105
101 - L.L. Grace.....	32	123 - Wi-Comm Electronics Inc.....	62
122 - Ham Radio Outlet.....	56, 57	110 - Yaesu USA.....	15
* Ham Radio's Bookstore.....	9, 37, 95, 100	179 - Yaesu USA.....	CIII
* The Ham Station.....	95	169 - E.H. Yost Co.....	105
* Hamtronics, NY.....	107		
* Hamtronics, PA.....	80		
* Heath Company.....	41		
* Heath Company.....	93		
103 - Henry Radio.....	27		
114 - ICOM America, Inc.....	CII		
161 - International Radio.....	99		
135 - Jun's Electronics.....	77		

PRODUCT REVIEW/NEW PRODUCT

301 - Alpha Delta Communications Inc.....	101
303 - Azimuth.....	103
304 - Bird Electronics Corp.....	105
* Ham Radio's Bookstore.....	101
302 - ICOM America, Inc.....	103

**ORDER
TOLL-FREE
-800-821-7323**

Dependable Service ✓ 177
At The Right Price . . . Everytime

MasterCard—VISA—Discover

Missouri Radio Center

KENWOOD



TS-940 "DX-CELLENCE"

- All Band, All Mode Transceiver
- Direct Keyboard Entry
- Engineered for the DX-Minded and Contesting Ham
- Its Got It All!

YAESU



FT-767GX

HF/VHF/UHF
BASE STATION

- Add Optional 6m, 2m & 70cm Modules
- Dual VFO's
- Full CW Break-in
- Lots More Features

ICOM



IC-761 HF "PERFORMANCE" RIG

- 160-10M/General Coverage Receiver
- Built-in Power Supply and Automatic Antenna Tuner
- SSB, CW, FM, AM, RTTY
- QSK to 60 WPM

uniden



HR-2510

- Mobile 10 Meter Transceiver
 - SSB/AM/FM/CW
 - 25 Watts PEP
 - Computer Controlled Operation
- SALE PRICED**

KENWOOD



TS-140S AFFORDABLE DX-ing!

- HF Transceiver With General Coverage Receiver
- All HF Amateur Bands
- 100 W Output
- Compact, Lots of Features

YAESU



FT-736R VHF-UHF BASE STATION

- SSB, CW, FM on 2 Meters and 70 cm
- Optional 50 MHz, 220 MHz or 1.2 GHz
- 25 Watts Output on 2 Meters, 220 and 70 cm
- 10 Watts Output on 6 Meters and 1.2 GHz
- 100 Memories

ICOM



IC-781 NEWEST SUPER RIG

- 5 Function Display Screen
- Built-in Spectrum Scope
- 150 Watts Output
- Built-in PS and AT

rconcept

2m and 220 MHz Amplifiers
GaAsFET Receive Pre-Amps
and High SWR Shutdown
Protection

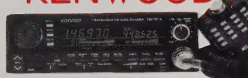
MODEL 144 MHz

MODEL	144 MHz	220 MHz
2-23	2 in/30 out	2 in/170 out
2-217	2 in/170 out	10 in/170 out
2-117	10 in/170 out	2 in/20 out
3-22	2 in/20 out	2 in/110 out
2-211	2 in/110 out	30 in/120 out
3-312	30 in/120 out	CALL

S
A
L
E

P
R
I
C
E
D

KENWOOD



TM-721A DELUXE FM DUAL BANDER

- 2 Meters (138.000-173.995 MHz) 70 cm (438.000-449.995 MHz) Receiver Range
- 45 Watts on 2 Meters
- 35 Watts on 70 cm
- 30 Memory Channels

YAESU



FT-212RH

THE "ANSWERING MACHINE" MOBILE

- Rx: 138-174 MHz
- Tx: 144-148 MHz
- 45W Output
- Digital Voice Recorder
- FT-712 RH for 70cm

ICOM

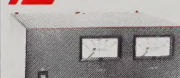


IC-900 SIX BANDS IN ONE MOBILE

- Remote Controller, Interface A Unit, Interface B Unit, Speaker, Mic and Cables
- Six Band Units to Choose
- 10 Memories Per Band
- Programmable Band Scan
- Fiber Optic Technology

SALE

ASTRON



- RS7A . . . \$50
- RS12A . . . \$72
- RS20A . . . \$92
- RS20M . . \$109
- VS20M . . \$129
- RS35A . . \$139
- RS35M . . \$155
- VS35M . . \$175
- RS50A . . \$199
- RS50M . . \$225
- RM50M . . \$245
- VS50M . . \$239

KENWOOD

TH-25AT POCKET-SIZED AND POWERFUL

- Frequency Coverage: 141-163 MHz (Rx), 144-148 MHz (Tx)
- Front Panel DTMF Pad
- 5 Watts Output
- 14 Memories
- TH-45AT Available for 440 MHz

YAESU



FT23/73R

- Super "Mini" HT's
- Zinc-Aluminum Alloy Case
- 10 Memories
- 140-164 MHz, 440-450 MHz
- 2W Battery Pack or Optional 5W Pack

ICOM

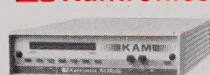


IC-μ2AT IC-μ4AT

MICRO HT'S
FOR 2M, 440

- Pocket Size HT Fun
- Ten Memories
- LCD Readout
- Wideband Coverage
- Up to 3 Watts Output
- 32 Built-in Subaudible Tones

Kantronics



KAM

- Packet, WEFAX, ASCII, AMTOR, RTTY, CW
 - Simultaneous Operation on HF and VHF
 - Personal Packet Mailbox™
- SALE PRICED**

102 N.W. Business Park Lane
Call For Best Trade-In Deal

Kansas City, MO 64150

Call Toll Free—9am - 6pm Mon.-Fri. 9am - 2pm Sat.
In Missouri Call—816-741-8118

MOST ORDERS SHIPPED SAME DAY

• DAIWA • HUSTLER

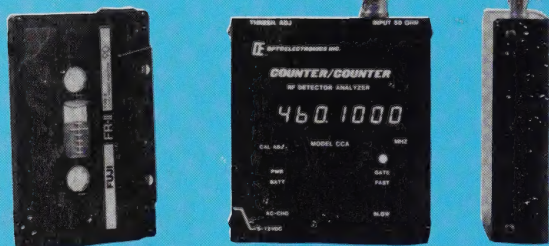
HYGAIN • ICOM •

KANTRONICS • KENWOOD • LARSEN • MFJ • MIRAGE/KLM • NYE VIKING • RF CONCEPTS • UNIDEN • YAESU

NEW**POCKET SIZE****SIZE: 4" H x 3.5" W x 1" D
MADE IN USA****OPTOELECTRONICS INC.**

FREQUENCY COUNTERS TO 2.4 GHZ

#TA-100S

**8 LED DIGITS • 2 GATE TIMES
ALUMINUM CABINET****INTERNAL NI-CAD BATTERIES INCLUDED
AC ADAPTER/CHARGER INCLUDED****EXCELLENT SENSITIVITY
& ACCURACY****AC-DC • PORTABLE
OPERATION**

Small enough to fit into a shirt pocket, our new 1.3 GHz and 2.4 GHz, 8 digit frequency counters are not toys! They can actually out perform units many times their size and price! Includes rechargeable Ni-Cad batteries installed inside the unit for hours of portable, cordless operation. The batteries are easily recharged using the AC adapter/charger supplied with the unit.

The excellent sensitivity of the 1300H/A makes it ideal for use with the telescoping RF pick-up antenna; accurately and easily measure transmit frequencies from handheld, fixed, or mobile radios such as: Police, firefighters, Hams, taxi, car telephone, aircraft, marine, etc. May be used for counter surveillance, locating hidden "bug" transmitters. Use with grid dip oscillator when designing and tuning antennas. May be used with a probe for measuring clock frequencies in computers, various digital circuitry or oscillators. Can be built into transmitters, signal generators and other devices to accurately monitor frequency.

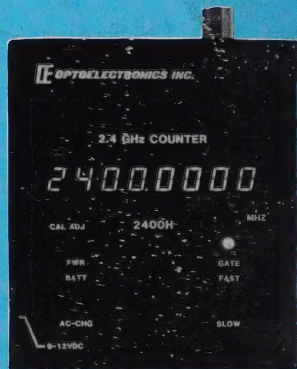
The size, price and performance of these new instruments make them indispensable for technicians, engineers, schools, Hams, CBers, electronic hobbyists, short wave listeners, law enforcement personnel and many others.

STOCK NO:

#1300H/A	Model 1300H/A 1-1300 MHz counter with preamp, sensitivity, < 1mV, 27MHz to 450MHz includes Ni-Cad batteries and AC adapter	\$169.95
#2400H	Model 2400H 10-2400 MHz microwave counter includes Ni-Cad batteries and AC adapter	\$299.95
#CCA	Model CCA counter/counter, for debugging, ultra sensitive, < 50 micro volts at 150MHz! 1-600 MHz with adjustable threshold, RF indicator LED. Includes Ni-Cad batteries and AC adapter	\$299.95

ACCESSORIES:

#TA-100S	Telescoping RF pick-up antenna with BNC connector	\$12.00
#P-100	Probe, direct connection 50 ohm, BNC connector	\$20.00
#CC-12	Carrying case, gray vinyl with zipper opening. Will hold a counter and #TA-1000S antenna.	\$10.00



✓ 178

ORDER FACTORY DIRECT

FLA (305) 771-2050

1-800-327-5912**AVAILABLE NOW!****OPTOELECTRONICS INC.**

5821 N.E. 14th Avenue
Ft. Lauderdale, Florida 33334

Orders to US and Canada add 5% of total (\$2 min, \$10 max)
Florida residents add 6% sales tax. COD fee \$2.
Foreign orders add 15%

Introducing the only mobiles that double as answering machines.

Now you can stay in touch—even when you're away from your radio.

With Yaesu's 2-meter FT-212RH and 70-cm FT-712RH, an optional, internal digital voice recorder serves as a convenient answering machine for you and your friends. And that's just the beginning!

High performance mobiles.

The FT-212RH features wideband receive coverage of 140-174 MHz (144-148 MHz Tx), while the FT-712RH covers 430-450 MHz. An oversize amber display includes an innovative photo-sensor which increases the display brightness during the day. The function buttons are arranged in a chromatic musical scale—ideal for visually-impaired operators. You get 45 watts output on 2 meters, 35 watts on 70 cm.

An autodialer DTMF microphone with 10 memories, each ready to store telephone numbers up to 22 digits long.

And, like our FT-211RH Series mobiles, you'll enjoy simple controls, yet sophisticated microprocessor-based flexibility. Including 18 memories that store frequency, offset, PL tone, and PL mode (PL encoder built in, decoder optional). Band or memory scanning. Offset tuning from any memory channel. Memory channel lockout for scanning. High-low power switch.

All in an amazingly small package, shown actual size below.

Digital voice recorder option.

Only Yaesu brings you the advanced technology found in our digital voice recorder option.

You can store messages or your call sign—in your own voice, not a synthesized replica—or give your friends a private code for leaving messages on your radio. All they need is a DTMF microphone! Then you can play back your messages either in-person, or remotely by using another radio with a DTMF microphone. And you've always got security because you can command your radio to respond only to in-person playback requests.

Visit your Yaesu dealer today.

And test drive Yaesu's FT-212RH and FT-712RH mobiles. The only radios with the power to keep you in touch. Always.

YAESU

✓ 179



Yaesu USA 17210 Edwards Road, Cerritos, CA 90701 (213) 404-2700. Repair Service: (213) 404-4884. Parts: (213) 404-4847.

Prices and specifications subject to change without notice. PL is a registered trademark of Motorola, Inc.

KENWOOD

...pacesetter in Amateur Radio

All-mode
tri-bander!

Warp Drive!



TS-790A Satellite Transceiver

The new Kenwood TS-790A VHF/UHF all-mode tri-band transceiver is designed for the VHF/UHF and satellite "power user." The new TS-790A is an all-mode 144/450/1200 MHz transceiver with many special enhancements such as Doppler shift compensation. Other features include dual receive, automatic mode selection, automatic repeater off-set selection for FM repeater use, VFO or quick step channel tuning, direct keyboard frequency entry, 59 memory channels (10 channels for separate receive and transmit frequency storage), multiple scanning and multiple scan stop modes. The Automatic Lock Tuning (ALT) on 1200 MHz eliminates frequency drift. Power output is 45 watts on 144 MHz, 40 watts on 450 MHz, and 10 watts on 1200 MHz. (The 1200 MHz section is an optional module.)

- **High stability VFO.** The dual digital VFOs feature rock-stable TCXO (temperature compensated crystal oscillator) circuitry, with frequency stability of ± 3 ppm.
- **Operates on 13.8 VDC.** Perfect for mountain-top DXpeditions!
- **The mode switches confirm USB, LSB, CW, or FM selection with Morse Code.**
- **Dual Watch** allows reception of two bands at the same time.
- **Automatic mode and automatic repeater offset selection.**
- **Direct keyboard frequency entry.**
- **59 multi-function memory channels.** Store frequency, mode, tone information, offset, and quick step function. Ten memory channels for "odd split."
- **CTCSS encoder built-in.** Optional TSU-5 enables sub-tone decode.
- **Memory scroll function.** This feature allows you to check memory contents without changing the VFO frequency.

- **Multiple scanning functions.** Memory channel lock-out is also provided.
- **ALT—Automatic Lock Tuning—on 1200 MHz** eliminates drift!
- **500 Hz CW filter built-in.**
- **Packet radio terminal.**
- **Interference reduction controls:** 10 dB RF attenuator on 2m, noise blanker, IF shift, selectable AGC, all mode squelch.
- **Other useful controls:** RF power output control, speech processor, dual muting, frequency lock switch, RIT.
- **Voice synthesizer option.**
- **Computer control option.**

Optional Accessories:

- **PS-31** Power supply • **SP-31** External speaker
- **UT-10** 1200 MHz module • **VS-2** Voice synthesizer unit
- **TSU-5** Programmable CTCSS decoder
- **IF-232C** Computer interface • **MC-60A/MC-80/MC-85** Desk mics • **HS-5/HS-6** Headphones
- **MC-43S** Hand mic • **PG-2S** Extra DC cable



Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications, features, and prices are subject to change without notice or obligation.

KENWOOD

KENWOOD U.S.A. CORPORATION
2201 E. Dominguez St., Long Beach, CA 90810
P.O. Box 22745, Long Beach, CA 90801-5745